Examination Papers for Civil Engineers before the New York Municipal Service Examining Board.

(*Continued from page 33.*)

Examination of Applicants for position of Rodman in Engineer Corps.

ARITHMETIC.

1. Reduce $\frac{\frac{1}{2}+3\frac{1}{3}}{\frac{1}{2}\times 1\frac{1}{3}\div x}$ to a decimal fraction, carrying the work to three places of decimals.

2. Add 10.6 + .00008. Subtract from the sum 5.01398. Multiply remainder by 4.101 and divide the product by .034. Carry out the answer to one decimal place.

3. If 120 men can build a half mile wall in 15¼ days, how many men would it require to build the same wall in 40⅝ days?

4. $75 is 12 per cent. of what sum?

5. What is the interest of $1024 for 10½ mos. @ 3 per cent. per annum?

MATHEMATICAL GEOGRAPHY.

1. What is latitude? Longitude?

2. What is the length of the earth's diameter?

ALGEBRA.

Find the value of x in this equation:

$$\frac{x}{8}-1+\frac{x}{12}-\frac{x+5}{4}=-\frac{11}{4}$$

GEOMETRY.

1. What is a polygon; a trapezoid; a rectangle; a square; a parallelogram?

2. The sum of the angles of a triangle is equal to what?

MENSURATION.

1. What is the area of a triangle whose base is 411 feet and whose altitude is 114 feet?

2. What is the area of a strip of tin 2½ feet wide at one end and 4 feet wide at the other, the length being 22 feet?

3. What is the area of a rectangular floor 25 feet wide and 39 feet long?

4. The radius of a circle is 10 feet; required the length of the circumference and the area contained.

PHYSICS.

1. Describe the lever; a wedge.

2. Describe the barometer.

SURVEYING.

1. Have you already served as rodman or in any capacity in an engineer corps? If so, give an account of the duties of a rodman. How should a rod be held to insure a correct reading from the instrument?

2. Tell what you know about bench marks, turning points, ground line, grade line, datum plane. Can you run a line of levels yourself?

3. What precaution should be taken in measuring up or down declivities?

4. How can you survey an irregular boundary, as the bank of a stream, by measurements only?

5. Describe a vernier.

6. How far have you studied in Mathematics?

Examination for Draughtsman.

Titles must accompany each sketch; and all bearings, stations and distances must be written in so as to exhibit skill in lettering.

1.—Plot the following traverse of a farm survey. If the boundary will not close, correct the plot graphically. Let the original lines remain in light pencilling, but ink in the corrected lines, showing also the method by which correction was made.

Also determine the contents graphically.

STATION.	BEARING.	DISTANCE.
1.	S. 21¾° W.	1762.
2.	S. 34° W.	1000.
3.	N. 56° W.	1415.
4.	N. 34° E.	976.
5.	N. 67° E.	280.
6.	N. 23° E.	703.
7.	N. 18½° S.	443.
8.	S. 65¼° E.	1079.

2.—A portion of the traverse of a preliminary railroad survey is as follows;

1st Course—N. 72° E. 1000 ft. to foot of cliff.
2nd " N. 60° E. 300 with " " "
3rd " N. 72° E. 200 " " " "

It is required to connect the first and third courses with a curved line of ten degrees curvature.

Also, determine the position of a church steeple, the bearing of which from the last end of the first course is south twenty degrees east, and from last end of third course is south thirty-six and one-half degrees west.

3.—A single track, ordinary gauge, railroad, iron, deck bridge is to be constructed over a large creek, and is to rest on two abutments and one pier, the latter in mid-stream. The angle of askew is ten degrees; that is, the bearing of the center line of the road is east, and of the channel, south ten degrees east.

The elevation of formation grade above datum plane is 97.5. Elevation of water line 39.0. Elevation of rock bottom 31.5.

It is required to design a masonry pier for this bridge, and to make an accurate working drawing of the same in elevation, plan and end view, showing all parts from chord blocks and coping to foundation courses and cut-water.

4.—Make a plain instrumental drawing of a masonry arched viaduct, something like High Bridge, in *perspective*. No details need be shown, as coping, skew backs, batter, etc., as the perspective is all that is required in this problem.

5.—Make a sketch of a ridge drained by brooks leading into a creek, the latter flowing into a river, add a forest, a marsh, a house, cultivated grounds, using conventional signs.

Examination of Applicants for Position of Topographical Engineer.

1. Define Topography. Mention some of the uses of topographical work.

2. Describe the Plane-table and its adjustments.

3. Name all the means, exact and approximate, by which distances can be ascertained, by which elevations can be determined.

4. Suppose you were required to make an accurate topographical survey of a valley with numerous branches, to be utilized for impounding water. What would be your plan of operations?

What would be your outfit of instruments?

How many men would you require to assist you in the field? What offices should each perform? Give some details of the work.

5. Suppose, on the contrary, you were required to make a very rapid topographical survey of a large valley (say two or three miles wide) to be only approximately correct. A staked railroad line traverses the valley for thirty miles. The stations, one hundred feet apart, indicate the distances and elevations along the line.

What would be your plan?

What would be your outfit?

What would be your party?

Give some details of the work.

6. Make a sketch of a hill with a river at its foot, showing the conventional signs. Add a brook, forest, marsh, cultivated ground.

A and B are stations on two mountains, the elevations of which have been accurately found to be 6473 and 4219 feet respectively. Station A is also determined in position by trigonometrical survey. Station B is not determined except that the bearing from A to B is known to be S 83° 15′ E.

An observer on another mountain C wishes to determine approximately, but as rapidly as possible, his position and elevation in order to sketch in upon the map the main features of the environs. He finds but one position from which he can see both stations: the bearings and angles he takes are as follows: C to A, N 5° 45′ W, angle of elevation 6° 30′: C to B, N 52° 45′ E, angle of depression, 5° 46′.

With these data it is required to calculate the observer's position with respect to the determined station A, and also his elevation.

General Information.

The general remarks made in the former examinations, apply to all grades except as specified below. The draughtsman is liable to have, besides his own paper, a few questions such as are presented to transitmen and levellers. The examination for topographical engineers is confined to such topics as appear in the paper above exhibited, and contains no arithmetic, algebra, geometry or physics except as these may be involved in topographical problems.

Arithmetic.—The same for all grades as for assistant engineer.

Algebra.—For rodmen, through equations of the first degree containing one unknown quantity; for levellers, through equations of the first degree; for transitmen and draughtsmen, through equations containing radicals.

Geometry.—For volume, that portion which in works on the subject is treated in advance of the propositions on circles; also, the rules for finding the area and the length of circumference of a circle of given radius; for levellers, through that portion which treats of similar polygons; for transitmen, all that portion which precedes the geometry of plans. The more practical of the theorems and problems are selected, especial importance being accredited to such as treat of the theories of the circle, of right-angled triangles and of similar polygons.

Trigonometry.—For rodmen, none; for levellers and transitmen, through plane trigonometry.

Physics.—For rodmen, levellers and transitmen, all that portion which in text books on the subject precedes the section on acoustics.

Books of Reference.—Rodmen are not allowed to use them. All other grades may consult them while solving problems requiring formulas or tabular numbers. For instance, in above series of papers, books may be used by candidates while engaged upon these questions: TRANSITMEN; *arithmetic*, No. 3; *surveying*, No's. 5 and 6; LEVELLER, none; DRAUGHTSMAN, No. 2; TOPOGRAPHICAL ENGINEER, No. 7.

Scheme of Weights.—For topographical engineer this is same as for assistant engineer, namely:

Efficiency and Accuracy in Work	15
Character for Maintaining Discipline	15
Experience	20
Technical Knowledge	50

In the examinations for rodmen, levellers, transitmen and draughtsmen, the following points are considered with the weights attached.

Handwriting	1
New York City Information	1
Arithmetic	1
Experience	2
Technical Knowledge	5

In other words, *handwriting, N. Y. City Information,* and *arithmetic* make each one tenth of the entire examination; *experience* is one fifth, and *technical knowledge* is one half.

Handwriting.—This is examined in the candidates' answers to questions on N. Y. City information.

N. Y. City Information.—The title explains itself. The writer of this communication takes no part in the examinations as to excellence in penmanship and knowledge concerning the city, and has nothing to say about them.

Arithmetic.—The effect of the system of weights for transitmen, etc., is to cause the portion of the paper devoted to arithmetic to be examined and marked separately. The remainder of the paper is considered to represent technical knowledge.

Experience.—See remarks in former communication.

The graduate of a scientific college who has had no experience ouside of college work, receives, nevertheless, full credit for experience as a rodman, if his work under examination warrants this. The same gentleman receives liberal credit for experience as a leveler or draughtsman, but none for experience as a transitman or engineer of higher rank.

Chronology of Steamboating.

The following chronological exposition of the origin, invention, and introduction of the steamboat and steamship is reliable:

The first idea of steam navigation was contained in a patent obtained in England by Hulls in 1736.

Fitch experimented in steam navigation on the Delaware River in 1783-4.

Oliver Evans was the next experimenter in steam navigation in 1785-6.

Ramsey was also an experimenter in Virginia in steam navigation in 1787.

W. Symington made a trial on the Fourth and Clyde with a small but rudely-constructed model of the steamer in 1789.

Chancellor Livingston built a steamer on the Hudson in 1797.

The first experiment in steamboating on the Thames, England, was in 1801.

Mr. Symington repeated his experiments on the Thames with success in 1802.

Fulton built the steamer, The North River, and made a passage up the Hudson River to Albany, from New York, in 33 hours—the first steam navigation on record. The engines were constructed by Boulton & Watts. The voyage was made in 1807.

The next steamboat was the Car of Neptune in 1808.

Fulton built the Orleans, at Pittsburg—the first steamer on Western rivers. It was completed, and made the voyage to New Orleans, 2,000 miles, in 1811.

The Paragon was the next steamer, built in New York in 1811.

The Richmond was built at New York in 1812.

The first steam vessels of Europe commenced plying on the Clyde in 1812.

The Vesuvius was built at Pittsburg in 1813.

Five steam vessels appeared in Scotland in 1813.

The first steam vessel to make a voyage up the Thames was brought to Glasgow by a Mr. Dodd in 1815.

England built her first steamer in 1815.

The Savannah, the first steamer to cross the ocean, was of 350 tons burden, and sailed for Liverpool from Savannah, Ga., July 15, 1819.

The first steamer in Ireland was in 1820.

Capt. Johnson was paid £10,000, or $50,000, for making the first steam voyage to India. The voyage was made on the steamer Enterprise, which sailed from Falmouth, England, Aug. 16, 1825.

The Great Western, from Bristol, England, and the Sirius, from Cork, Ireland, both arrived at New York City, each on their first voyage, and each eighteen days out, on June 17, 1838.

The first steamer of the Cunard Line to arrive on American shores was the Britannia, which arrived at Boston after a passage of fourteen days and eight hours, in July, 1840.

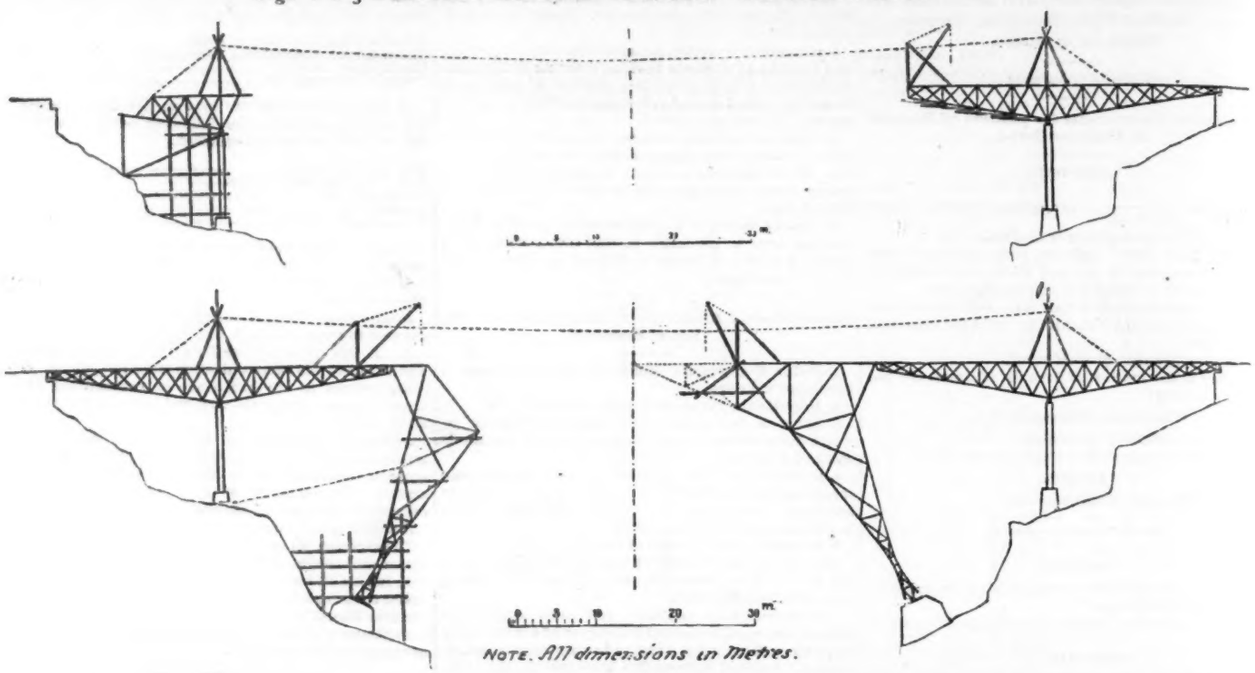
The first war steamer built in England was in 1838.

Returns from twenty-three States gave an aggregate of 700 steamboats in the United States in 1838.

There were about 1,500 steam vessels in the United States in 1847.

The Washington was the first American ocean steamer of note. She made her first passage to Southampton, England, in June, 1847.—*N. Y. Marine Journal.*

Figs 1 2 3 – BLAAUW-KRAUTZ VIADUCT. CONSTRUCTION.



The Viaduct of Blaauw-Krantz, Cape Colony, Africa.*

M. Am Ende has published in the *Centralblatt fur Bauwessen* a description of a very original bit of construction in the Cape Colony. The article includes the method of calculation, but of this we only reproduce a sufficient portion to express the tendency of what may be called the most advanced school in metallic construction. We are tempted to call it the rationalistic school, if that word has indeed a position and generally admitted application. By this we mean the tendency to set aside all traditions, all consideration of form, more or less artistic, and all compromise with generally accepted ideas, To answer a manifest purpose, by the most economical solution and one altogether free from any artifice, seems to be its only end. To this school we are already indebted for a number of works which merit the name of scaffolding rather than that of works of art.

The following is a description of the Viaduct of Blaauw-Krantz as given by M. Am Ende: The railroad from Port Alfred to Grahamstown, opened on Sept. 10, 1884, crosses the deep ravine of Blaauw-Krantz, with sides of granite very much broken up and very abrupt, and having a depth of about 197 feet (60m); with the given local conditions that all material must be brought from England, stone alone excepted, it was necessary to design a structure containing as little iron and wood as was possible. As wood for scaffolding was also scarce, another consideration was to make the members as light as possible so as to facilitate the raising and diminish the number of men required.

In response to this programme, advantage was first taken of the conformation of the gorge by placing on the sides trusses of slight dimensions, constructed as continuous girders, as shown in Figs. 1, 2 and 3. The shore truss was erected first, then the second as a cantilever, and this last served as a point of support for the construction of the third member, or one half of the main span. The arch had a span of $229\frac{6}{10}$ feet (70.02m). The shore trusses were firmly anchored to the masonry and the overhang of the arch was thus resisted, and its construction advanced towards the key as in a cantilever. When finished by the meeting of the arch at the key the structure presented the appearance shown in Figs. 4, 5 and 6.

During the construction a cable of iron wire (Fig. 1.) served to convey material from one side to the other of the ravine.

When the work was completed, the connection between the shore spans and the main arch was cut, and a slip joint substituted which would only transmit vertical reactions. But during the erection these beams were securely connected with the arch as they then transmitted a horizontal force; the fastening was a pin capable of carrying a load of 35 tons. These bolts were left in the slip joint after the completion of the bridge as an additional security.

The arch proper is without hinges, either at the spring or at the key. But to facilitate the erection and to realize to the fullest extent the effect provided for in the calculations, three hinges were introduced in the construction, which were suppressed when the completed structure found itself free to take the form due its own permanent weight. For this purpose the feet of the arches were placed upon hinges, held down by bolts having a very slight play. The plates forming the base of the arch shoes were kept about one *centimetre* from the granite pedestal by a moderate tightening of these bolts. This space was afterwards filled with cement and when this had hardened, the bolts were loosened so as to leave the plate free. The strains existing in the members abutting on the hinge thus found themselves transmitted to the various members in a very uniform manner, with a very slight displacement in the entire arch.

This plan of mounting being adopted it was necessary to calculate the effect upon the arch from two different hypotheses. First: to figure the arch as having three hinges, under its own weight. Second: to consider it as fixed at the base, so as to arrive at the effect of an accidental load. The strains in each member of the construction, resulting from either condition were then summed up. The determination of the sections of the members was by a mode of calculation which takes into consideration the moments of inertia of successive sections of the arch. This calculation gives for the fixed arch three equations with three unknown quantities, the evolution of which enables us to determine the required sections. With these sections it is then possible to make a very close calculation taking into account the variation of length in the different members according to the method or M. Mohr.

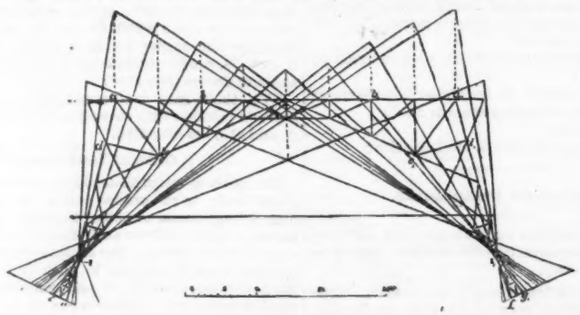


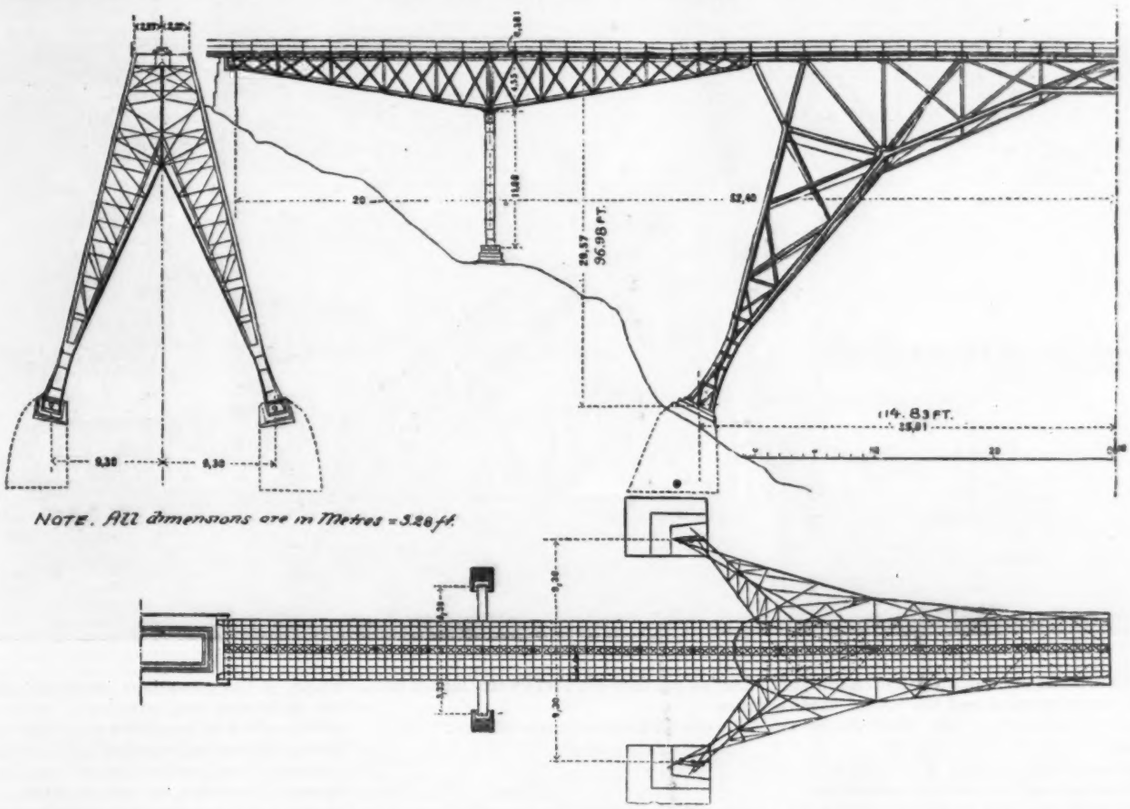
FIG. 7.

The method of calculation followed out by M. Am Ende is the usual method of moments by vertical cuts and the substitution of the forces required to produce equilibrium. Fig. 7 represents the reactions as calculated.

The transverse bracing of the arch consists of six distinct systems; that is, four systems, radiating in plan, $a\,g$, $a'\,g'$, $b\,f$ and $b'\,f'$, and two others $a\,c\,a'$ and $d\,e\,c\,e'\,d'$ (Fig. 7.) When the wind produces horizontal strains upon the arch, there follow, at the crossing points of the various systems, reciprocal reactions which enter into the calculations of these members as unknown quantities. If it were possible, by the aid of these strains and the loads, to establish expressions for the displacement of each of the points in question, the equations following would be sufficient to calculate these reactions. But, in addition to the direct loads,

*Translated for ENGINEERING NEWS from *Le Genie Civil* Dec. 6, 1884.

FIGS. 4, 5, 6.—BLAAUW-KRAUTZ VIADUCT. CROSS-SECTION, ELEVATION AND PLAN.



there is rotation or torsion, which produces the effect of a load transverse to the plane of the system into which it is desirable to divide the structure, and in consequence they have an effect upon the simple deformation. This circumstance renders the calculation so very complicated, that it may be classed as inextricable. An approximate calculation gives results which can be used in this special case, but they have hardly sufficient interest to be reproduced here. We confine ourselves to remarking that, under the total load and the effect of a wind of the greatest force, there are produced at the connections *a, b, d, e*, forces of about + 19 $\frac{3}{10}$ tons, + 104 $\frac{7}{10}$ tons, −57 $\frac{9}{10}$ tons and + 87 tons. With these figures determined it is an easy matter to deduce the strains in the various members forming the structure.

The loads used in the computation are as follows: The rolling load is 2466 lbs. per lin. ft. (3,678 kilos. per running *metre*). This provides for a train of locomotives weighing each 70,531 lbs. (32,514 kilos.) and having a length of 29 ft. (8.84 m.) The roadway is 3 ft. 5 in. gauge. The temperature is figured under a variation of 104° F. (40° C.) In calculating the effect of a horizontal wind pressure, the figures accepted in France were adopted, that is 30$\frac{1}{2}$ lbs. per square foot (150 k. per square metre.) for the loaded bridge, and 55 $\frac{35}{100}$ lbs. per square foot (270 k. per square metre) without the load.

Under the load the different parts of the arch are submitted to strains varying from 2 $\frac{1}{10}$ tons per square inch to 3 $\frac{17}{100}$ tons per square inch (3.5 to 5 k. per square *millimetre*). When the wind pressure acts at the same time, the strain is raised to about 4$\frac{1}{2}$ tons per square inch (7.5 k. per square millimetre).

The total weight of the bridge, including a platform of plate iron, is about 627,000 lbs. (285,000 k.). Its total length being 485 $\frac{1}{10}$ ft. the mean load per running foot is about 1294 lbs.

The bridge has been submitted to various tests. 1st:—Two engines coupled were placed upon the bridge in three different positions. 2nd: A train was passed over made up of four engines and 16 loaded cars, representing a load of about 1811 lbs. per lin. ft., and this with varying speed, touching 20 miles per hour. 3rd. A train was ran on to the bridge at 15 miles per hour and abruptly stopped by the brakes as near as possible to the middle of the bridge.

These tests proved perfectly satisfactory, in so much that all flexure was well within the elastic limit of the material, and there was no permanent set. The flexure reached a maximum of $\frac{6}{10}$ inches (15 *millimetres*) at the crown of the arch and $\frac{24}{100}$ inches (6 millimetres) towards the extremities. The lateral oscillation was very slight and disappeared after the passage of the train. The entire work was built from the plans of M. Am Ende, at the shops of Handyside & Co. Derby, England.

Cost of Concrete.

BY EMILE LOW, C. E.

The following notes on the cost of concrete result from observations made during the construction of the Hiland Avenue reservoir of the Pittsburgh New Water Works.

This is the largest reservoir of that system, having a total capacity of 117,650,188 gallons, of which the larger compartment holds 80,534,685 and the smaller 37,115,503 gallons. The larger compartment has a bottom area of 493,678 square feet or 11 $\frac{33}{100}$ acres, while the area of the smaller is 217,330 square feet or within a fraction of 5 acres.

The entire surface, with the exception of a narrow strip around the edges occupied by the stones skewbacks supporting the stone passing on the inner slope, is covered with concrete to the depth of 5 inches, or 0,417 feet.

The total quantities in the two compartments were respectively 7681 and 2254 cubic yards, for which the contract price was $6.00 per cub. yd. According to the specification:—"the concrete shall be composed of one part of hydraulic cement mortar, and two and one half parts of clean gravel, or broken stone, free from dirt, and broken so as to pass through a two and a half inch ring.

It shall be quickly and thoroughly mixed, and immediately deposited in place, and rammed until the mortar flushed to the surface; no walking or working over it shall then be allowed until it is set."

The cement mortar mentioned above was to be prepared from the best quality of American hydraulic cement, fresh burnt, and clean sharp sand, free from loam. It was to be thoroughly mixed dry, in the proportion of one part cement to two parts of sand; a sufficient quantity of water to be added to produce a paste of the proper consistency, and the whole worked thoroughly with proper tools; only two kinds of cement were used, one called the Phœnix, manufactured at Uniontown, Pa., and the Louisville. The broken stone composing the concrete was quarried along the left bank of the Allegheny River, a short distance below the mouth of the Kiskiminitas River, and transported by rail to Haights Run, a distance of about 20 miles, there unloaded and reloaded on smaller cars, hauled up an inclined plane from the top of which the cars were hauled over a narrow gauge railroad (built for this purpose) having a grade of 211 feet to the mile, to the reservoir site about $\frac{1}{2}$ mile distant. The spalls resulting from the dressing of the cut stone and rubble masonry and stone paving used in the construction of the reservoir, were also utilized, and formed a no inconsiderable portion of the whole amount used.

The character of the stone employed will be seen from the following analysis of the same:

KISKIMINITAS SAND STONE.

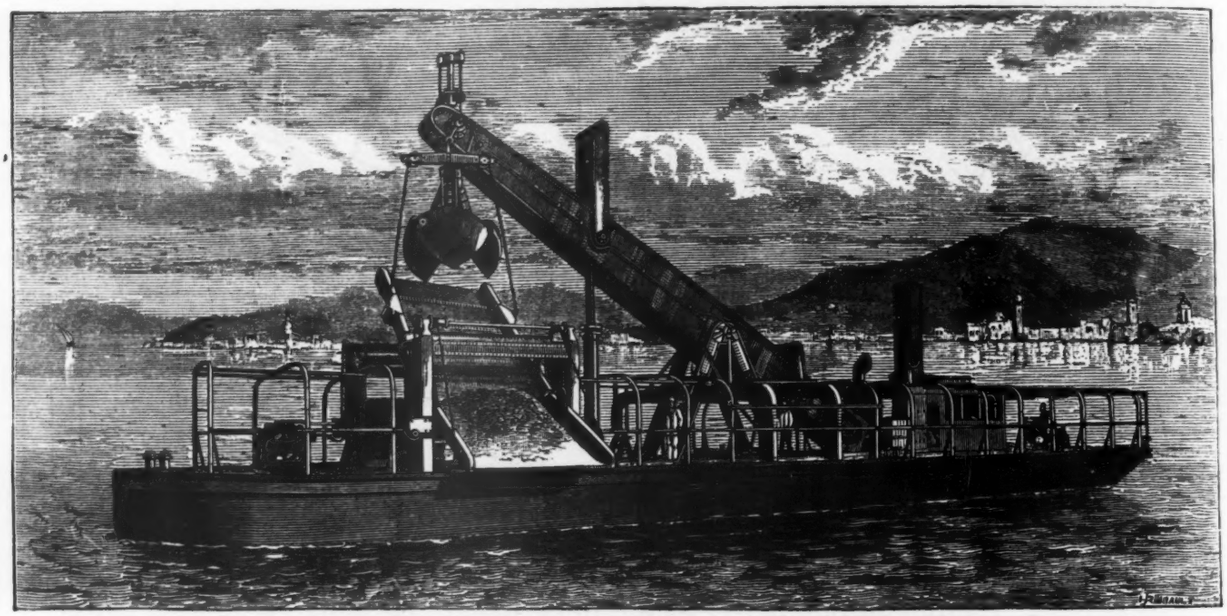
Water	0.22
Silica	88.75
Alumina	2.84
Peroxyde of Iron	0.48
Lime	3.97
Magnesia	3.74
	100.00

Samples of the stone were subjected for fully three weeks to Bard's test, they remaining almost intact, proving that the frost will have very little or no effect upon them.

The stone varied in weight from 146.75 to 151.5 pounds per cubic foot.

The cost of quarrying the stone was 45 cents per cubic yard, and the cost of transportation

BRUCE AND BATHO'S DREDGER.



averaged 50 cents per cubic yard, or a total of 95 cents per cubic yard, and the cost of breaking 35 cents, making a total cost of the stone $1.30 ready for use in the concrete.

The author has no record of the cost of laying the concrete in the smaller compartment, and that work was done in strong contra distinction to that laid in the larger one.

In the smaller compartment the broken stone was first deposited to the required depth of five inches, on the puddle which formed the first bottom layer, and the cement mortar being reduced to the consistency of thin grout in suitable boxes, was then poured over the stone until the grout rose to the top, and filled all the interstices.

The concrete thus made was then rammed until the mortar flushed to the surface after which it was allowed to harden and set.

In the large compartment the mode of procedure was different: First, platforms were prepared, made of two inch plank, ten feet wide and sixteen feet long, and laying flat on the ground, or rather on the puddle which formed the bottom of the reservoir.

In addition there were used wooden boxes, supported by legs, in which the grout was made. These boxes were five feet long four feet wide, and one foot and a half feet deep. Into these boxes two barrels of sand and one barrel of cement were deposited at a time, and the two thoroughly incorporated dry, when a sufficient quantity of water was added to form a thin grout.

The stone, of which five barrels were placed at a time on the platform, were first thoroughly wet, with clear water, and then the grout was poured over the same, the whole mass being turned over three times with shovels and then deposited on the puddle to the required depth of five inches, and afterwards rammed until the mortar fused to the surface.

From memoranda in possession of the author it is found that, during one month there were mixed and laid 1,425 cubic yards at a cost of 95 cents per cubic yard. The wages paid were for laborers $1.25 and to foremen $2.50 per day.

At another time occupying two days there were mixed and laid 101 cubic yards. The cost of labor was as follows:

1 foreman	2 days at	$2.50	$ 5.00
27 laborers	2 "	$1.25	$72.90
	Total		$77.90

making the cost of one cubic yard 77 cents.

During another day there were laid 42 cubic yards.

The cost of labor being as follows:

1 foreman 1 day at $2.50		$ 2.50
27 laborers 1 "		$36.45
Total		$38.95

making the cost of laying 92½ cents per cubic yard. This is, however, not a fair average, as the men labored under some disadvantage on account of a short supply of water.

During another month there were laid 1,302 cubic yards of concrete.

The cost of labor was then as follows:

642 days laborers	$1.35		$866.70
17 " water boys	.60		10.20
22 foremen	2.50		55.00
Total			$931.90

making cost per cubic yard $71\frac{57}{100}$ cents.

It usually took one and a third barrels of cement and eight bushels of sand, in addition to the stone, for each cubic yard of concrete.

Most of the sand was procured from within the reservoir limits, and merely cost the price of excavation, being one and one quarter cent per bushel.

The average price paid for the cement was $1.35 per barrel.

From these figures we have then the total cost of concrete laid in the work per cubic yard:

Quarrying stone	$ .45
Transportation	.50
Breaking	.35
Cement	1 80
Sand	.10
Water	.05
Labor of mixing and laying	.75
Incidentals	.05
Total	$4.05

As the contract price was $6.00 per cubic yard there was a profit of $1.95, or nearly 33 per cent to the contractor.

Bruce & Batho's Dredger.

THE above engraving represents a dredger, on Messrs. Bruce & Batho's system, lately constructed for use in British Burmah. It is designed to work to a depth of 15 feet, and is of the following general dimensions; length 120 feet; breadth, 32 feet; depth, 7 feet; and mean draught, 3 feet. The vessel is propelled by twin screws worked by independent pairs of high-pressure engines, supplied by steam from an ordinary marine multitubular boiler 9 feet in diameter by 9 feet 6 inches long. The whole of the operations involved in working the excavator are performed by hydraulic power, which is furnished by a pair of direct acting differential pumping engines with steam cylinders 15 inches in diameter, and pumps $4\frac{11}{16}$ inches in diameter, the stroke of both being 18 inches. All the rams are controlled by slide valves placed amidships, so that one man can regulate the whole of the motions without leaving his station. The elevator is mounted on the end of a beam pivotted on frames fixed to the deck. This beam is raised into the position, in which it is shown in the engraving, by a hydraulic ram, about half way between the centre and the excavator, and it is caused to descend partly by the weight of the excavator, and partly by a smaller hydraulic ram near the other end. The excavator itself is worked by two rams coupled together by side rods, so that they move in unison. The lower and larger ram is connected by rods to the three segmental scoops, and serves to draw them together when they are receiving a load of soil, shingle, or rock, a pressure of 30 tons being available and amply sufficient for that purpose.

The smaller ram opens the excavator when it is raised. The two hydraulic cylinders with the hemispherical shell and the casting to which its component parts are attached, are hinged to the beam by a universal joint, through the trunnions of which the pressure water enters. The shoot for discharging the spoil is connected to the beam and follows the excavators ready to receive its load as it falls. The speed of working is about forty lifts an hour, and, as the excavator has a capacity of 160 cubic feet, the work done amounts to 300 tons per hour.

Up to the present seven dredgers have been constructed on Messrs. Bruce and Batho's system, and four have been supplied to the Government of India, and are giving the most satisfactory results both as regards working expenses and economy in the cost of maintenance and repairs. As may be seen from the official reports to the Government of India, the cost of dredging with one of these machines is now only 1d. per cubic yard, while after some years of work the dredger was described as "perfect in every way." The fact that all the working parts are either on board, out of water, or above the material acted upon by the excavator, accounts for the differences in wear and tear as compared with the bucket and ladder type of dredger.—*Engineering.*

The Problem of Just Apportionment of the Cost of Ditch Improvements.*

BY E. B. OPDYCKE, C. E., BRYAN, OHIO.

As the Ohio Legislature has seen fit, in recent years, to cast upon the shoulders of Engineers and Surveyors the main part of the responsibility in the location and construction of county ditch improvements, we should take pride in performing our duties faithfully, impartially, thoroughly, conscientiously and firmly. The most difficult and delicate among the various duties thus devolving upon the Engineer, is that of making a just apportionment of the cost of ditch construction. Into the hands of the Engineer, in the first intance, are thus placed the scales of justice, to weigh upon this delicate matter, and to make a proper adjustment of the shares of a contribution for a special purpose.

Presuming ourselves to be possessed of justice-loving minds, it becomes us to be diligent in availing ourselves of all information from every source which shall aid us in refining upon the results of apportionment: and the closest approximations to true results can only be reached by the employment of correct methods, by the careful accumulation of the proper data, and by the exercise of the utmost scrutiny in our calculations. As a basis for the apportionment of the cost of ditch construction, our Legislature has taken its position emphatically upon the principle of benefits derived. (Sec. 4492, Vol. 1, R. S.)

We are pleased to state that we do most heartily accord with this position, and that we regard the principle of benefits derived as the only truly equitable principle upon which to make assessments for the cost of ditch construction. Although the principle upon which assessments must be made seems clearly established, yet, in practice and by investigation, we find that the problem of apportionment is very abstruse: that it has been solved only in a general way; we find that there is no treatise upon the subject, which shall serve us as an infallible guide in all the details of a true process, and that, at best, our results can be but approximately true.

The term "benefits derived" answers the question How much more will the property be worth after the improvement is made than its present value? W. H. Burroughs, in his treatise on Taxation, in Drainage and Levee cases, says on page 459: "The increased market value of the lands is the true rule of assessment." Judge Cooley, in his treatise on Taxation, while referring to the estimation of benefits on page 459, says: "We must consider what the property is now fairly worth in the market, and what will be its value when the improvement is made."

Benefits may be divided into two classes, according to our legal authorities: namely, special and general. Special benefits are local in nature while general benefits are common to the public at large. It will be found upon examination of our authorities that special benefits constitute the chief ground for making assessments and that therefore, such benefits should be regarded the principal basis for determining the apportionment. In order that we may bear in mind the distinction held between taxes and assessments, and to show that assessments must be made for special benefits, we quote first from the decision rendered in the case of Hale *vs.* Kenosha 29 Wis., page 599 as follows: "Taxes, it is said, are impositions for purposes of general revenue: assessments are special and local impositions upon property in the immediate vicinity of an improvement laid with reference to the special benefit which such property derives from the expenditure."

Judge Cooley, in his treatise on Taxation says: "The expense of constructing drains in order to relieve swamps or marshes, or other low-lands, of their stagnant water, is usually provided for by special assessments. The special benefits from the enhancement of values, must accrue mainly to the owners drained who ought, therefore, to bear the expense." Again he says on page 421: "But where any considerable tract of land owned by different persons is in a condition precluding cultivation by reason of excessive moisture which drains would relieve, it may well be said that the public has such an interest in the improvement and the consequent advancement of the general interest of the locality, as will justify the levy of assessments upon the owners for drainage purposes."

W. H. Burroughs, in his treatise referred to says: "The levee and drainage cases, so far as held valid, are all based upon the principle of special benefit."

In the case of Chamberlain *vs.* Cleveland, 34 O. S., Page 551, the Court say: "Assessments can only be constitutional when imposed to pay for local improvements, clearly conferring special benefits on the properties assessed, and to the extent of those benefits."

Thus we find that all of these authorities fix the limit of assessments within the bounds of special benefits, and that the tribunal of our own State emphasizes this limit as being alone coincident with constitutional jurisdiction. An apportionment is wrong which assumes to make an assessment exceed the benefits derived in the increased value of the property.

It is clear that such an assessment, in so far as it should exceed the benefits, would be the imposition of an injustice upon the owner of the property: that to enforce the collection of such excess would be an unwarranted exercise of the power of eminent domain, that, thus far, it would be an appropriation of private property to public use without just compensation, and therefore, unconstitutional. In support of these statements we adduce the following authorities:

Judge Cooley, on page 417 of his treatise on Taxation, says: "The justice of demanding the special contribution is supposed to be evident in the fact that the persons who are to make it, while they are made to bear the cost of a public work, are, at the same time, to suffer no pecuniary loss thereby; their property being increased in value, by the expenditure, to an amount at least equal to the sum they are required to pay."

In the case of Chamberlain *vs.* Cleveland, referred to in another place, that portion of the decision quoted, which holds assessments to be constitutional only when imposed to the extent of the special benefits conferred by their improvement, also sustains the point under consideration. In another case it was decided that: "Assessments are justified on the ground that the subject of the tax receives an equivalent."

In another case, cited on page 477 of Judge Cooley's treatise, there is this decision: "It is a *local* assessment imposed occasionally, as required, upon a limited class of persons interested in a *local* improvement, and who are assumed to be benefited by the improvement to the extent of the assessment; and it is imposed and collected as an *equivalent* for that *benefit* and to pay for the improvement. In all these cases it is known only and distinctively as an assessment for benefits."

More particularly relating to the injustice and unconstitutionality of assessments which exceed the benefits, we cite as follows:

Judge Cooley, on Taxation, page 461, says: "Any assessment is wrong which charges lands with a sum beyond the benefits received." A decision cited by him from the 35 N. J., page 497, holds that: "Where the cost of drainage is assessed upon lands without reference to the fact whether they are benefited or not, to that extent, this constitutes an appropriation of private property to public uses."

In Illinois a similar case was held to be unconstitutional. W. H. Burroughs, in his treatise on Taxation in Drainage and Levee Cases, says: "Equality is the rule, and while the legislature have a very large discretion on the subject, and it may be very difficult to define the limit beyond which they may not pass, yet, when it is plain as to a particular individual that he receives no benefit from the imposition of the local assessment, then, as to him the assessment is not a tax; it is a taking of private property for public use without just compensation, and the assessment is void."

Having adduced a few of the authorities that define the limits beyond which we may not pass in determining the amount of an assessment in any case, we shall now direct an attack upon a popular fallacy in regard to what should be the extent for making assessments.

We shall denominate it the fallacy of the watershed. The fallacy rests upon the erroneous assumption that all lands, to the extent of the watershed, must be assessed for the construction of the ditch; that all lands whose waters flow into the line of the proposed ditch should be included in the special taxing district. We do not denounce the assumption as being false in every case, but we denounce it because of its sweeping generality—because of its making benefits necessarily coextensive with the watershed in all cases. In accordance with this assumption, while we are locating the ditch and surveying the lands as to benefits, the following expressions from the owner of the lower lands will greet our ears, such as:

"The water from A B and C's land runs down over my land into the line of the proposed ditch," or, "If it were not for the water from A B and C's land, a tile would carry the water from my land;" and then he most confidently expects us to assess those lands.

Elevation of the land to a sufficiency for the most thorough drainage without the construction of the proposed ditch, interposes no impediment to the pertinacious and ever faithful adherent of the watershed, or dividing line of the waters, as the only true limit to the special taxing district. We may stop and show the error of the position, but, like a swamp-angel, the same error will meet us very cordially in the next swamp to give us the familiar greeting. The fallacy, fully stated, would be somewhat as follows:

"Although A, B and C's lands are sufficiently elevated so that they can be thoroughly drained without the construction of this ditch, yet they should be compelled to assist in its construction, first, because the water coming from their lands necessitates the construction of a larger ditch than would otherwise be required; and second, because they possess no right to have the water from their lands flow upon the land below; and the privilege being one of consent, and not of imperative right, as against the lower owner, they should be compelled to purchase this right by being assessed to aid in the construction of this ditch."

The argument is fallacious because it assumes that the higher land possesses no right to have the water, which falls upon it and which naturally flowed down over the lower land, thus to flow; and then suggest that such right can only be acquired by purchase, which purchase can be made by its submission to an assessment for the construction of ditch below. The assumption is contrary to judicial decisions on that point, and therefore the conclusion is false. We may premise that if the upper owner possesses a right to have the water which falls upon his land flow down over the lower owner's land in the channels or depressions through which it has been accustomed to flow, he cannot then be assessed for the construction of ditch below, simply because such is the direction of the discharge of the water; for, if he be assessed in such case, it would virtually be causing him to purchase a right which he already possesses, providing the right could so be acquired. We have then but to show, by judicial decisions, that the upper owner does possess such right, in order to refute the popular fallacy and to substantiate the true doctrine in these cases.

In the case of Martin *vs.* Jett, 12 La., page 501, the Court say: "The Civil law is, where two parcels of land lie adjoining each other, belonging to different persons, and one parcel lies lower than the other, that the lower one owes a *servitude* to the upper to receive the water that *naturally* flows from it, provided the industry of man has not been used to create the servitude."

Washburn on Easements, page 450, says: "It may be stated as a general principle that by the Civil law, where the situation of two adjoining fields is such, that the water falling or collected by melting snows and the like upon one, naturally descends upon the other, it must be suffered by the lower one to be discharged upon his land if desired by the owner of the upper field." Again on page 306, he says: "Because water is descendible by nature, the owner of a dominant or superior heritage has an *easement* in the servient or inferior tenement, for the discharge of all waters which by nature rise in, or flow, or fall upon the superior."

In a recent Illinois Supreme Court case of Eli Peck and Sackett Booth *vs.* James Herrington, the Court said, on this point: "It may be regarded as a well settled principle of law, that where two farms adjoin and one lies lower than the other, the lower farm will be subject to the natural flow of water from the one which lies in a more elevated position. The owner of the upper field, in such a case, has a natural easement, as it is called, to have the water that falls on his own land flow off the same upon the field below, which is charged with a corresponding servitude in the nature of dominant and servient tenements."

We will present a case from our own State, the case of Butler *vs.* Peck. In the course of the decision in this case, the Court say: "The principle seems to be established and indisputable, that where two parcels of land, belonging to different owners, lie adjacent to each other, and one parcel lies lower than the other, the lower one owes a *servitude* to the upper, to receive the water which naturally flows from it, provided the industry of man has not been used to create the servitude."

While much more authority could be presented to establish the right of the dominant owner as against the servient, in matters of natural drainage, sufficient has already been adduced in support of that right, to absolutely invalidate the position of those who, either directly or indirectly, assume contrary grounds. Therefore, this right being established, assessments cannot be imposed upon lands simply because the water flows from them into the line of the proposed ditch. Hence, also, the watershed cannot necessarily determine the true limit of the special taxing district. But, as some animals are said to have nine lives, so with this question; for no sooner is that fallacy crushed, than another, phœnix like, rises out of its very dust. The new fallacy assumes this form: "The upper owner ought to be assessed to construct a ditch below, even though his land is so elevated that he could thoroughly drain it without the construction of the ditch: because, in the advancement of agriculture he will increase the flow below; he will send it down in more rapid volume and thus cause damage to the lower lands, and for this damage he will be held liable. He has no right thus to swell the volume of water below, until he shall have assisted in providing a channel of adequate capacity for the increased flow." We meet this fallacy at its very threshold, deny the positions taken, and condemn them as being unsustained by the authorities.

We acknowledge that the argument appears plausibly sound at first glance, but its apparent solidity will vanish, as fog before the noonday sun, when the light of Court decisions is shed upon it.

In the case of Martin *vs.* Riddle, 26 Pennsylvania St., page 415, the court says: "A man may make whatever drains in his own land, are required by good husbandry, either open or covered, and may discharge these into the natural channel or channels, even though by so doing he increases the quantity flowing therein.

H. G. Wood on Nuisances, Section 385, says: "A person may drain his land and relieve it of the water lying inert upon the surface, or that is under the surface mingled with the soil itself, and if his neighbor is damaged thereby, it is '*damnum absque injuria*,'" In Section 391 he says. "The owner of the upper or superior heritage has a right to improve his lands for agricultural or mining purposes, in the ordinary manner, although the volume of water on the lower is thereby increased."

Nathaniel C. Moak, on Torts, page 457, says: "The upper estate is entitled to a natural servitude upon the estate situated below it, for purposes of drainage."

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*Read before the Society of Ohio Engineers and Surveyors, at Columbus, January, 14th, 1885, and printed by permission.

case, referred to in another place, there was this principle stated, in connection with the main decision: "It may also be regarded as a well settled rule that the owner of the upper field cannot construct drains or ditches so as to create new channels for water in the lower field, but he may make such drains for agricultural purposes, on his own land, as may be required of good husbandry, although by so doing the flow of water may be increased in a regular, well-defined channel, which carries the water from the upper to the lower field," and "surface depressions where water naturally runs in times of excess, are to be construed as the water course."

In our own State we will simply refer you to J. Brinkerhof's decision to be found in the 12, O. S., page, 298; The upper owner, then, having an easement upon the land of the lower, for the drainage of his land, he is not liable for any damage that may occur to the lower owner from the proper exercise of his right.

There may be those who still feel allured by the plea of damage set forth in the fallacy, and upon the ground of that plea they may feel inclined to regard the conclusion as valid. These we would refer to any treatise which discusses the principle of "*Damnum absegue injuria.*" We especially refer you to H. G. Wood on Nuisances. In Section 880, he says: "There are a multitude of uses to which one may devote his own property that operates injuriously to another for which no damages are recoverable. A man is never liable for the results of the proper exercise of a lawful act. * * * In all cases of nuisance, before the bringing of an action it should be first ascertained whether a legal right has been violated; if so, a nuisance exists; if not, no nuisance exists, and, however great the damage, it is *dammum abseque injuria*."

We have seen clearly, then, that an upper owner has to *increase* the flow through natural channels, upon the lower lands, and having this right, he is *not* liable to the lower owner for damage resulting from its proper exercise. It also clearly follows that the upper owner cannot be assessed to construct ditch below, simply on the grounds that he may cause damage to the lower owner or owners, when he shall increase the flow through natural channels upon their lands; for, to assess him upon such grounds, would be equivalent to a denial of the right which is conceded to him by our highest authorities. Therefore, in fine, to assess lands for the construction of ditch improvements upon the erroneous assumption of this last popular fallacy also, would be recreant to the logical outcome of the true doctrine on the relative rights of drainage between dominant and servient owners.

Having observed some of the general limitations which must govern us in the discussion of the problem of apportionment, we shall examine in detail a few of the principles which shall aid us towards a correct solution of the problem. We may state, in preliminary manner, that however true the principles and sound the method of apportionment employed, the result will be but a greater or less approximation to the ideal result which inheres only in the highest conceptions of justice. The very elements and date, which enter into the problem, in practice, render the results approximate.

1st. Since an assessment for the cost of an improvement cannot lawfully exceed the increased market value of the property, and since, as is a common observation, the profits derived from the drainage of wet lands are very great and the productiveness or increased productiveness thus brought about will soon repay the cost of drainage, we would advise a very liberal estimate for such increase of value when preparing data for an appointment of the construction of the ditch. Then whatever the method of apportionment employed this liberal estimate of increase of the value, should constitute a bar against excessment. If the estimate were not a maximum, and the cost of the improvement should exceed the estimate, then either the improvement could not be made or the excess might be unjustly cast upon the shoulders of the public; whereas, the most liberal estimate might have equaled or exceeded the cost, and thus the improvement could have been made.

2nd. The estimated cost of a ditch improvement should be made only high enough to insure a sale of the work, and most especially when such cost is liable to exceed the increased market value of the property assessed. For, if the estimated cost be excessive, it may exceed the increased market value of the property to be assessed, and therefore, according to principles hitherto laid down the construction of the improvement would thereby be precluded, unless the surplus were assumed by the public. Whereas, if a minimum estimate for the cost of the improvemant had been made, the property might have enjoyed the advantages which would accrue from the establishment of the improvement, and not have been caused to delay until the advanced value of the property would justify the levy of assessments thereon for the construction of the improvement.

3rd. The cost per cubic yard for each station of 100 feet, or for such other length as the statute pronounces a station, should never be made uniform over the entire line of the improvement, unless the quality of the work will unquestionably warrant so doing. Graded rates per cubic yard should be made, in order, 1st, that the relative cost of the various stations and portions of the improvement may be known, and 2nd, that a just apportionment of the cost may be more nearly approximated. The objection to the establishment of a uniform rate per cubic yard, for the entire line, will not be removed by asserting that the aggregate cost may amount to the same in either case. In some of the counties it still continues to be the practice to allot to the assessed owner a defined portion of the improvement to construct, *as well as* his apportionment of the cost thereof. In such practice (and we prefer it for certain reasons) the adoption of a uniform rate per cubic yard, where graded rates should have been employed, would most clearly make manifest the injustice of such a method. The principles laid down in this section, will be more readily understood when we shall have discussed, a little farther on, other principles relating thereto.

4th. L. D. Whiting, of Illinois, in a paper on Drainage, most properly divides the same into two classes, 1st, "Individual drainage, where the owner has his own outlet independent of others, and 2nd, combined drainage, where one cannot drain without joining others." In the first case, according to principles hitherto laid down and so far as drainage is concerned, no assessment can justly be imposed upon the owner for the construction of ditch below. The second class furnishes the chief ground for making assessments. Since, in this class, the upper owner or owners have insufficient outlet for the thorough drainage of their lands until the same is opened upon the lots or lands below, it is evident that the obtainment of such outlet will yield a benefit to these upper lands. When the lower lots or lands likewise require the opening of this outlet for their thorough drainage, they, also, will be benefited by the construction of the same. There is, therefore, thus presented us a combination of benefits, and hence the expense of constructing this outlet must be shared equitably between the upper and the lower lands. In this connection, we also note a concise and sound decision; one prolific of principles, and which, in its logical outcome, sustains the conclusions deduced. It may be found in Washburn's treatise on Easements and Servitudes, page 461. It is this: "The lower owner, however, is not obliged to open ditches on his own land to draw off the water from his neighbors' land."

In order to illustrate more clearly some of the principles already laid down, and to render more readily comprehensible other new principles which we desire to develop, we present an example: We will suppose there to be two one-hundred-acre-swamps, the one owned by A and the other by B; that they are separated by a high, well drained land for a distance of one mile; that the water channel connecting these swamps is six feet in depth, availing the full benefit of this high ground; that the line between the lands of A and B is midway between the swamps; that these swamps are similar in appearance and seem in like condition in every respect; that no other but these swamp-lands will be benefited by the construction of a ditch for their drainage; that a ditch is located commencing at the upper part of A's swamps, extending through it and the channel which already exists through the high ground between the swamps, continuing through B's swamp, until 300 feet below the same, sufficient outlet is obtained for the thorough drainage of both swamps; that the cost of the improvement would be equally divided at the line between A's and B's lands; that that portion of the improvement extending from the upper line of B's swamps to the terminus, will avail to the full benefit of his swamp, as an outlet, and that the final value of these lands will warrant each in the assumption of its proper share of the expense of the improvement. What should be the method of apportionment in such a case? The superficial observer would perhaps go upon the line of the improvement and say: "Since these swamps are equal in area, exactly similar in appearance, condition, etc., their increase of value per acre (which we will suppose is $50) must certainly be the same. The entire increase of value to each swamp tract will be $5,000, and upon this basis each must bear an equal share of the cost of the improvement."

The result, itself, has invalidated the method of procedure, and the method of procedure has contravened the indisputable principle, that: "The lower owner is not obliged to excavate ditches, or construct sewers, on his own land, for the purpose of draining the low or marshy lands of an adjoining proprietor," for, according to supposition, B's land would not be benefited by the construction of the improvement above his swamp, and yet, by the result, he has been caused to construct one-half mile of the improvement above his swamp. Owner A should construct the improvement to B's swamp tract, until mutual benefits arose, when the cost of the improvement through and below B's tract to the terminus, must be shared equitably between them. So then, B cannot justly be caused to bear the expense of improvement, by which his tract will be benefited. But when the employer of this method is clearly shown his erroneous results, he is perhaps staggered to understand wherein his method is false. The swamps being of equal area, precisely similar in appearance, and all that, he fails to comprehend why his method is not logical to a fault. His method has violated a very important principle—a principle which will be found of general application in these cases, viz.: A true method cannot propose dividing between lots or tracts of land that which is not of common benefit to such lots or tracts. His method, in the example given, has divided between the tracts of A and B, the cost of the entire improvement, whereas, B's tract would be benefited by the construction of but a portion of the improvement. In order to make the principle still more clear, and, assuming that in each case, the final value of the property will exceed the cost of the improvement, we shall attempt to cast more light upon it by means of a brief analysis. The term "benefits derived," as applied to land, implies a change of condition; and that change must be toward a betterment of the condition. This change must then be from a bad, to a better condition. There is also, impliedly, a valuable utility in the land, to be developed.

We find upon examination that the causes of the bad condition are two, viz.; surplus water and want or difficulty of outlet. If the rainfall were only sufficient to meet the requirements of the soil, then, the cause, want of outlet, would not be apparent; so likewise, if there were sufficient outlet for conveying away the surplus water, that case would also vanish. The concurrence of both causes is necessary to produce the effect—bad condition. The relative badness of the condition will vary with the ease or difficulty by which a good or better condition can be brought about. The more difficult and expensive the outlet, the farther removed is the land from a good condition, and hence the worse the condition. Then, other things being equal, the worse the condition which pertains to one tract of land, as compared with another, the greater the share of expense in the construction of outlet which it must expect to bear as compared with the other.

It will thus again appear why A's tract must be caused to bear a greater portion of the expense than B's. The tract of A requiring the construction of the entire improvement before it shall have sufficient outlet for through drainage, and B's tract of equal size requiring the construction of but a portion of the improvement, the former will be in a worse condition than the latter, and hence the conclusion. If this rude analysis and the general principle, that a true method cannot propose dividing between lots or tracts of land, that which is not of common benefit to such lots or tracts, be carefully observed, other subordinate rules can be deduced for guidance toward making a just apportionment.

6. It is also clear that the cost of a ditch improvement cannot be taken as a whole, and be divided between the benefited areas, in one process, when not all of such areas will be benefited by the entire improvement; for to do so, would be to violate the general principle just proposed. In no case could such method of procedure yield true results, except when the premises were first made to conform to what should be the results; but this would render the employment of premises superfluous. To apportion the cost of a ditch, as a whole, and under one process, however, would probably realize the expectations of those who imagine that, by having many branch ditches located upon their lands, in connection with the main improvement, they will be relieved from assessment for the construction of their main and necessary outlet. The fallacy of this position, (a position with which we often meet), we show its urgers in this manner: If the location of one branch upon your land will relieve you to to an extent from assessment upon your main and necessary outlet, and two will relieve you more, perhaps the location of a dozen branches will not only relieve you from assessment upon the main outlet, but others will be called in to assist you in draining your land, though you alone are benefited by the construction of these branches. Hence, the absurdity of the position.

7. It also plainly appears from foregoing principles, that a benefited area can only be assessed for the construction of a ditch, from the point where it begins to be benefited, to a point where it ceases to be benefited; and this latter point will be determined by the proper outfall required for the thorough drainage, and to avail the full benefit of such area. It is evident, also, that the stronger the natural fall below, the sooner will the benefited area be relieved from assessment, and the lighter the fall, the farther down the improvement will it be assessed; thus its assessment may continue to but a short distance below, or it may continue to the terminus of the improvemeet for miles below.

8. Low-land derives more benefits from the construction of a ditch, than land which is higher, but which is still benefited; so, benefits are found to decrease as elevation of the land increases. Then a ditch of given dimensions and fall, which avails the fullest benefit of the lower lands, will exceed the requirements of one which will fully benefit the higher lands. Therefore, according to the rule that: A true method cannot propose dividing between lots or tracts of land that which is not of common benefit to such lots or tracts, there will be a portion of the expense of this ditch, which should not be divided between the lower and the higher areas. This idea suggests, that in connection with a system of ratios of benefits, (whose base we assume as 100), there must also be a system of ratios of cost for the various depths and dimensions of a ditch, for which we assume a base of 1000. We make these as mere suggestions, since their full discussion would far transcend the proper limits of a paper.

9. Since the lower areas must bear the chief part of

the burden of assessment, they should either be measured or very carefully estimated; for a slight variation in the most important data will produce very different results, and carelessness in the accumulation of these, will fail the ends of justice.

10. It has been said, that: "The great object to be sought in drainage is to lower the water-level in the low-lands and marshes; and this is equivalent to raising the surface of the land to an equal extent, with the same rich soil." It should be observed in this connection, that land which has but one half foot greater elevation than other adjoining land, will hold great superiority over such land; for it requires upwards of eight hundred cubic yards of earth to raise an acre of land, one-half foot. Then in apportioning the cost of constructing a ditch, we must not forget the superiority arising from greater elevatiou in the case of drainage benefits.

11. The benefits derived from fall as compared with a ditch having a level bottom, are, 1st The more speedy removal of the water, and 2nd. the clearing of sediment from the channel. Fall may either be too light most fully to serve the purposes of the same, or it may be too heavy, thereby causing undue erosive action on the bottom and sides of the channel. The rate and amount of fall required to avail full benefit to land, will vary with different cases, and will depend on, 1st: The speed with which the water must be removed, to best subserve the desired purpose. 2nd: The volume of water to be carried away, and 3d: The character of the soil through which the ditch passes, as regards its power to withstand the erosive action of water. Then, if a given gradient suffices the full benefit of a lower area, each higher area would properly be assessed to construct a section of the ditch, whose grade is parallel with the given gradient

12th. It has frequentlv been observed, that a ditch which has no fall, whose bottom is level, serves a good purpose in the reclamation of land. Then, since a ditch with a level bottom, is superior to no ditch, it follows, that land which has such a ditch, is in a much better condition than land which has no ditch. As an indirect deduction from these statements, we would say, that it should ever be borne in mind, whilst making a comparison of benefits between different elevations along the line of a ditch that *greater elevation yields superior position.*

13th. How shall we determine the maximum of benefit which shall accrue to the public, from the drainage of roads, in order that a correct basis may be obtained for making assessments upon the public? The difficulty which seems to lie in the way of understanding how to measure correctly the amount of benefits which will accrue to the public, from the drainage of roads, as compared with the benefits resulting to agricultural lands, consists in the diverse purposes for which each is improved in condition. The one is improved in condition for the purposes of carriage; the other, for the purpose of production and the like. The question to be answered, in the case of roads, is analogous to that, in the case of lands. We must inquire: How much more will this road be worth to the public after the improvement is made, than its present value? or, the equivalent may be asked:

How much can the public afford to invest in this improvement so that the same shall remain a profitable investment? If, in any case, the public alone should be benefited by the construction of a given ditch, then the public alone should bear the cost of the improvement. The question naturally arises in such a case: What amount must constitute the maximum limit of assessment upon the public for the construction of the improvement? The amount so determined must constitute the basis of assessment, whether the public alone, or individuals also, are benefited. A true method by which to determine the amount of benefits, resulting to the public from the drainage of roads; a true method by which to decide upon the maximum limit of assessments to be imposed on the public in these cases, is suggested by a general statement made in Gillespie's excellent treatise on Roads and Rail-Roads. It is a statement worthy of very careful consideration, one of these which, though so clear, is yet so prolific of other subordinate principles that are to aid in the solution of question at hand. The statement is this: "If an improvement in roads can be made for a sum of money, the interest of which will be less than the total amount of the annual saving of labor, it will be true economy to make it, however great the original outlay; for the decision of all such questions, depends on considerations of comparative profit." It is clear from this statement that the aggregate annual saving of labor in the expense of carriage, repair of roads, etc., must constitute somewhat more than the interest of a sum which the public could profitably invest in the improvement; and this sum must be the basis upon which to make an assessment. If, for example, the total annual saving of labor were $31., and interest 6% per annum, the sum which would constitute the basis of assessment would be at least, $500,. But the questions still arise: How are we to arrive at an estimate of this total annual saving? and, what are we to include in this estimate? In making our estimates of the annual saving to the public from the drainage of the road, we must not imagine that drainage will remedy all defects and reach the ultimatum of a perfect road.

Every writer, however, concedes the importance of drainage to roads and speaks in strong terms, of the benefits which a lowering of the water-level yields to them. Gillespie says: "Drainage alone will often change a bad road to a good one, and without it no permanent improvement can be made."

Among those things which must be considered in making our estimates of the benefits derived by the public, from the drainage of roads, are; 1st. The amount and nature of the traffic which passes over the same; for this would imply the importance of the road to the public, and the more important the road to the public, the more it could wisely expend in its improvement: 2nd The annual saving of carriage and power which the drainage of the road would effect: 3rd. The annual time in passage over the road with either light or heavy burdens: 4th. The annual saving in cost of repairs of the road; and 5th. The total annual saving to the public which will result from the contribution, as it were, made by drainage in rendering the road susceptible of receiving other ordinary improvements, which could either not have been made at all, or not made so well, without the drainage. All these and other things which the drainage of the road will effect, must be considered in order to estimate the aggregate annual saving to the public, and this annual saving may be regarded as somewhat more than the interest of an amount that must constitute a full measure of the benefits which will result to the public from the construction of the ditch.

14. We should note one exception to this rule, however which rests upon the principle that the public, as well as an individual, should be entitled to the privilege of making its improvements by as cheap a method as possible. The exception is this: If the object—a good road,—can be reached by a less costly method than by drainage, then, the advantage of the lesser cost should be given to the public, and its assessment should be made only equal to such lesser cost.

15. When a ditch is located along a highway and the excavated earth is to be cast upon the road bed, as the statute requires, the extra expense of so doing, should be imposed upon the public, for the incidental benefit. This amount must be deducted from the cost to be apportioned before making the apportionment.

16. We would add somewhat as to principles for making assessments on corporations for the benefits derived by railroads, from drainage, but such principles as apply in the case of ordinary roads will, for the most part, apply to railroads. We forego any further discussion of the principles of apportionment, as our paper has already exceeded the bounds of patience.

Manufacture of Relievo Maps.

The following ingenious method of making relievo maps has been patented in this country (England) on behalf of Mr. J. J. de Mendonca Cortez, of Lisbon. In maps which are drawn to scale it is usual to indicate the variations in the contour of the land by a series of continuous curves or lines, each representing a rise of, say, one hundred feet. In constructing relievo maps according to this invention as many proofs of the map of the district to be modelled in relief are struck off on metal or paper from the stone or engraved plate, as there are hypsometrical or height-indicating curves drawn on the map for the district in question. These proofs or maps are then laid out upon, and suitably attached to, perfectly smooth and level plates of metal, card, or other suitable material. The thickness of these plates is proportionate to the equidistance of the hypsometrical curves, and care must be taken in laying down the proofs, if on paper, not to stretch or contract them. The several plates are then laid upon a suitable table and carefully cut out by means of a fine band saw or knife or other suitable means, care being observed to follow exactly the lines of the hypsometrical curves, and a different height curve being cut around in each plate. There will result from this operation a series of inner cuttings of different sizes and various contours, and also a series of corresponding outer or marginal cuttings. The inner cuttings are accurately laid, the one upon the other, in order of size, and fixed by means of glue, solder, or otherwise, upon a perfectly level bed plate, by which means an exact and proportioned relievo is obtained of the map under treatment.

It should be remarked that if paper proofs have been used, it will be necessary after adjusting, but before fixing together the several cuttings or overlays, to detach the paper from the metal or other plates. To effect this detachment without injury to the plates, the latter may be washed in water, spirit, turpentine or other suitable fluid. This model in relievo, or core, is then marked with several gauge points, by means of which the position of the map to be moulded in relief can be readily adjusted. The next step is to cover this core with a sheet of moistened paper, of a thickness equal to that of the paper of the map to be moulded in relief, which thickness can be ascertained by a gauge indicating hundredths and thousandths. Upon the core thus composed of the inner cuttings and covered with the moistened paper, the outer, or marginal, cuttings are severally adjusted by means of the gauge points above referred to, and in such a way that the narrowest marginal cutting, or that plate which has the largest aperture, is applied next to the base plate; the next sized marginal cutting upon the narrowest, and so on up to the last marginal cutting, or that plate which has the smallest aperture corresponding in size and contour to the inner cutting indicating the highest level of the ground, and forming the top of the core. The cut-out plates being thus perfectly adjusted, two or more holes strictly vertical are made therein, outside the engraved district of the map, to facilitate adjustment, and the moistened paper is then withdrawn. By this means an exact model in relief, or core, and a complementary model in intaglio, or matrix, corresponding accurately thereto will be obtained, and will constitute a die suitable for moulding in relief a map on paper of the proper thickness.

The extent to which the paper of the map to be moulded in relief will bear stretching or distension having been well ascertained, the map is placed upon the core and its position adjusted by the gauge points above mentioned, and moistened as often as may be desired by any suitable means such as a badger or camel-hair brush. The marginal cuttings are then laid in succession over their corresponding sections in the core, and are accurately adjusted by means of the holes made in them, the paper of the map being drawn or pressed more or less as required to conform to the desired contour. The paper being again moistened, another marginal cutting is superposed on the preceding one, and so on to the last one the strains or distortions of the paper being always gradually and proportionately corrected by the application of gentle pressure and moisture. Finally, a perfectly level plate is laid upon top, and the whole is subjected to pressure in a suitable press. The top plate and the marginal cuttings are then carefully removed one by one beginning at the top, and the map moulded in steps in relievo is removed from the core; thoroughly dried and then stiffened by strong shellac or other suitable varnish or medium. It is then mounted in a case in such a manner as will best protect it from injury. If a continuous or natural relievo map is desired, the plate must be cut with a bevel along the hypsometrical curves, and the marginal plates must be formed with overhanging bevels to correspond.—*Building News.*

Weights of Pipes and Castings.—The weight of pipes and cylinders is often required by the surveyor and engineer. The rule to find the weight in pounds is to subtract the square of the inside diameter in inches from the square of the outer diameter in inches. Multiply the result by 7.4 and divide by 3. Multiply lastly by the length of the pipe in feet. The weight of castings may be determined thus:—Multiply the width in quarter inches by the thickness in eighths of an inch, and divide the product by 10, then multiply the result by the length in feet. For wrought iron add 1-20th to the result. Flat castings and bars are of constant requirement, and their weight can be found by the simple rule of multiplying the width in inches by the thickness in inches and by the length in feet, and then for cast-iron by 3½, and for wrought 3¾.

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THE trade outlook seems to be brightening; the improvement is slight and the signs of the times somewhat difficult of a true interpretation but they are encouraging. From Pittsburgh, Easton, Cleveland, Chicago, Reading, and other iron manufacturing centers, comes word that operations are being resumed; an increase in orders is reported and many of the iron operators predict that rock bottom has been reached in prices and that the next thirty days will see a decided improvement therein.

Manufacturers have been taught that it is not well to expend money in extending to an unwarranted degree, existing works, to meet a demand that experience proves is too soon filled to repletion. In the future they will be more likely to hoard up the certain profits of the day of prosperity, than to spend them in discounting future trade and in expanding facilities they already have.

With steel rails at $28 per ton, and bridge builders cutting prices per pound to the thousandth part of a cent, it does seem that now is the time for the building of new work, and repairs and betterment of the old. Money is plentiful, and could be economically expended; confidence in the times alone is lacking, and that now seems to be steadily on the mend.

Annual Meeting American Society of Civil Engineers.

THE Annual Meeting of the American Society of Civil Engineers opened at the Society House in New York on Wednesday, Jan. 21, at 10.30 o'clock. In the unavoidable absence of the President of the Society, Mr. D. J. Whittemore, Vice President, Wm. H. Paine, presided.

The Secretary then formally announced the general programme for the two days session, which has already been published in this journal. The first report read was the annual report of the Board of Directors. The report shows the Society to be in a flourishing condition; the net gain in membership of all classes, during the year 1884, was exactly 100, making a present total membership of all classes of 878. This is a greater increase than in any one previous year since the existence of the Society. The regular meetings held during the year were twenty in number, including the last Annual Meeting, and the Buffalo Convention; all were well attended. The Society House is now substantially half paid for; the library includes 15,000 separate titles and a number of very valuable contributions in books were received in the past year. The attention of the members was forcibly called to the great importance of adding to the library by all means possible, as it was being more and more used as a library of reference by resident and visiting engineers.

The announcement was made that the Norman Medal for 1883, had been awarded to Mr. Gustav Lindenthal, for Paper No. 263, on Rebuilding of the Monongahela Bridge at Pittsburgh, Pa., and that the Rowland Prize for 1883 had been awarded to Mr. W. P. Shinn for Papers on the Efficiency of Railways in the Transportation of Freight.

The Treasurer of the Society, Mr. J. J. R. Croes, reported that the ordinary receipts for the year 1884 were $17,679.10; and the ordinary expenses were $14,639.74. He also reported fully upon the general financial status of the Society and the disposition of its permanent and building funds.

The Finance Committee reported as having audited all the Society accounts in accordance with the regulations provided.

The Norman Medal for the year 1884, was awarded by the Committee to James Christie for Paper No. 279, on Experiments on the Strength of Wrought Iron Struts; and the Rowland prize for 1884, was given by the same Committee to Hamilton Smith Jr., for Paper No. 274, on Water Power with High Pressures and Wrought Iron Water Pipe.

The ballot for officers of the Society for 1885, was then announced with the following result —Frederic Graff, President; Geo. S. Greene Jr., Thomas J. Whitman, Vice Presidents; John Bogart, Secretary and Librarian; J. James R. Croes, Treasurer; Theodore Cooper, William R. Hutton, Walter Katté, O. Chanute, and F. W. Vaughan, Directors. President-elect Mr. Graff took his seat and in a few well timed remarks expressed his thanks to the Society, and his personal gratification for the honor conferred upon him.

The proposed amendment to Article XXII, of the Constitution was then taken up. This amendment, already published to the Society, relates to the compounding of future annual dues by the payment of $250. and a further sum of $10 annually for the term of five years by resident members. A lively discussion followed, the chief bone of contention being the unequal assessment of resident and non-resident members under the ruling of the original amendment; in other words that the effect was to give an undue advantage to the resident member in the relief from the annual payments. After a somewhat lengthy talk the matter was finally referred to a committee of the chief objectors, and later, an amended amendment was submitted to the Society. This was to the effect that the future annual dues could be compounded by the payment of $250. but that resident members should remain liable to the payment of the difference now existing between resident and non-resident dues in addition to the compounding sum, or, if they should so elect, the resident members could compound in total by the payment of a further sum of $75, making $325 in all. This new amendment, and another, making the monies received from this compounding process, a permanent fund of which the interest only was to be used, was approved by the Annual Meeting and recommended to the Society for letter ballot.

The Secretary announced to the Society the death of the late Honorary Member of the Society, Mr. John B. Jervis: Mr. Wm. P. Shinn and Mr. A. M. Wellington gave a brief sketch of the life and professional record of the deceased, and the Board of Direction were directed to appoint a Committee to prepare a memoir of Mr. Jervis, to be published in the Proceedings of the Society.

The circular to members relating to the place and future method of holding the annual Conventions of the Society called out 183 written replies. Of these the greater number simply agreed with the suggestions made by the Board; the majority of the replies advocated the suppression of the reading of lengthy papers at the Convention meetings, as being "dry fodder" and consuming valuable time; the printing of these papers, in full or by abstract, previous to the time of meeting; the advisability of the Society paying its own way, and finally of the substitution of the Board, or a Committee of the Society, for the local reception Committee and its subscription papers. In reference to the place of meeting for the next annual Convention a multitude of suggestions were made; among them, Baltimore, Saratoga Springs, the Catskills, White Sulphur Springs, Bermuda Island, New Orleans and Newport. Mr. Stacy P. Opdyke, Jr., and Mr. Locke, on behalf of the railroad companies they represent and the connecting lines, tendered to the Society the courtesies of the roads running from New York and Boston to Saratoga Springs, via. the Hoosac Tunnel. On motion of Mr. Jos. P. Davis, the meeting placed the matter of selecting the time and place of the next Convention in the hands of the Board of Direction with a request that the proposition relating to Saratoga Springs be duly considered.

The General Manager of the American Exhibition, to be held in London, England, in 1886, formally invited, by letter, the American Society of Civil Engineers to hold its Annual Convention for that year in the City of London. Rooms for meeting would be furnished, arrangements for reduced steamer rates made, and all possible courtesies extended. The invitation was accepted subject to future action of the Society.

After a generous and handsomely appointed lunch served in the Society House the afternoon session was opened by the reading of the report of the Committee on Standard Time, by Professor Egleston, in the absence of the Chairman, Mr. Sandford Fleming. The report outlined the very satisfactory results of the late International Conference in Washington, viz; the adoption of the Greenwich Meridian; the counting of the degrees of longitude 180° East and West from this meridian; the adoption of a universal day for astronomical, nautical and civil purposes beginning at mean midnight; and the approval of the 24 o'clock system. The committee further reported that 178 prominent officers of railroad companies had been heard from, and of these 98 per cent. were in favor of the 24 o'clock method; these men represent over 59,000 miles of railroad. The President of the Western Union Telegraph Co. stated to the Committee that the proposed change in time nomenclature would save their company the transmission of 150,000,000 words annually in telegraphing. The report of the committee was accepted and the committee

continued. On motion of Mr. Macdonald the Board was directed to appoint a committee to attend and officially represent the Am. Soc. C. E. at the several Time Conventions of the railroad companies. There was some discussion as to the advisability of introducing a decimal subdivision of the hour as an addenda to the 24 hour movement.

The committee on a Uniform System for Testing Cements made a most elaborate, practical and valuable report, which we will publish in full as soon as possible. The aim of the committee has been to occupy a middle ground between the careful laboratory tests and the crude methods often employed; and to recommend a method simple, rapid, easy of application and reasonably accurate. A vigorous discussion followed the reception of this report; some of the members present, while commending the patient and intelli ent work of the committee and the great practical value of the report, objected to the testing for tensile strength only, and the slight attention paid by the committee to the importance of tests for compression. The seeming approval by the Society of *any* limiting test for tensile strength was also objected to by a few members. The report was finally received and the committee discharged.

At the evening session on Wednesday, the attention of the Society was called to imperfections in our Patent Office system whereby it now takes months, where it ought to take only weeks, to obtain a patent. The subject was referred to the Board of Direction. Mr. Wm. P. Shinn then offered a resolution calling for the appointment, by the President of the Society, of a Committee to confer with Committees from other Engineering Societies, upon the subject of consolidating the libraries of the several organizations; after some lively discussion the resolution was passed. The Annual Meeting was then adjourned sine die, and the rest of the evening was devoted to the explanation by members, and others, of the especial features of the points of interest about the city to be visited by the members on Thursday Jan. 22. Maps and plans were exhibited to illustrate these remarks, among them a most beautifully executed pen-drawing of the Dow's Stores in Brooklyn, showing the building in section.

The programme for Thursday has already been given in this journal, but we must defer until next week any further detail of the carrying out of this programme.

MEMBERS PRESENT.

Geo. H. Brown, Supt. Pittsburg W. W., Pittsburg, Pa.; Chas. G. Darrach, Phila., Pa.; H. D. Blunden, Eng. M. of Way, N. Y. L. E. & W. R. R.; Cook Talcott, New York City; C. B. Brush, Hoboken, New Jersey; L. F. Beckwith, E. B. Van Winkle, J. E. Brown, Jr., L. L. Buck, of New York City; Jas. Owen, Newark, N. J.; D. E. McComb, Washington, D. C.; John MacLeod, Chf. Eng., K. & I. Bridge Co., Louisville, Ky.; Julius F. Sorzano, New York; S. J. Fields, Niagara Bridge Works, Buffalo, N. Y.; Fred. Brooks, Boston, Mass.; E. B. Weston, Asst. City Eng., Providence, R. I.; Arthur Beardsley, Prof. Civil & Mechl. Engineering, Swarthmore, Pa.; Gustav Lehlbach, Newark, N. J.; W. H. Searles, Cleveland, Ohio; A. M. Wellington. Ed. *Railroad Gazette*; A. B. Hill, City Eng., New Haven, Conn.; C. J. H. Woodbury, Boston, Mass.; J. W. Ferguson, Asst. Eng., N. Y. L. E. & W. R. R.; Oberlin T. Smith, Bridgton, N. J.; M. T. Endicott, Civil Eng., Phila. Navy Yard; F. H. Hewes, New York; G. Leverich, South Orange, N. J.; Saml. M. Gray, City Engineer, Providence, R. I.; J. Foster Crowell, P. R. R. Co., Philadelphia; C. Neilson, Laflin & Rand Powder Co., New York; F. Collingwood, Elizabeth, N. J.; John F. O'Rourke, New York; Gorham P. Low, Gloucester, Mass.; Chas. W. S. Seymour, Hingham, Mass.; Wm. Metcalf, Pittsburgh, Pa.; Thos. C. McCollum, Civil Eng., U. S Navy. New York; Casimir Constable, New York; Fred. S. Odell, New York; Clark Fisher, Trenton, N. J.; Wm. H. Wiley, Wm. P. Shinn, Chas. W. Hunt, B. F. Booker, Geo. A. Just, Cooper Hewitt & Co., J. J. R. Croes, Chief Eng., Suburban Rapid Transit Co., Jos. P. Davis, A. F. Sears, H. W. Parkhurst, James B. Eads, A. P. Boller, Thos. F. Rowland, Wm. F. Booth, Alfred W. Trotter, Wm. R. Hutton, Stephen S. Haight, Stevenson Towle, W. E. Worthen, all of New York City; Chas. E. Goad, Montreal, Canada; Stacy B. Opdyke Jr., Supt. N. Y. & N. R. R. New Haven, Conn.; H. Bissell, B. & M. R. R. Salem, Mass.; Clemens Herschel, Eng., Holyoke Water Power Co., Holyoke, Mass.; A. W. Locke, Manager T. & G. R. R. Co., North Adams, Mass; G. M. Rusling, Hackettstown, N. J; J. M. Knap, C. C. Schneider, New York; Frederick Graff, *President* Am. Soc. C. E., Philadelphia, Pa; Thomas C. Clarke, C. D. Ward, Thos. J. Long, Dept. of Docks; Ed. P. North, F. A. Calkins. D. McN. Stauffer, Ed. ENGINEERING NEWS; F. L. Fuller, W. H. Paine. *Vice Prest.* Am. Soc. C. E; Geo. H. Bishop, M. N. Forney, S. I. Johnson, Suburban Rapid Transit Co.; Ed. R. Andrews, Theodore Cooper, Consulting Eng., G. B. Mallory, John G. Van Horne, all of New York City; Henry R. Towne. Stamford, Conn; L. F. Olney. Newburg N. Y.; A. G. Compton. Prof. Applied Mechanics Col. City of New York; T. Guilford Smith, Buffalo, N. Y.; Chas. Macdonald, Union Bridge Works, New York; W. W. Maclay, Dept. Docks, New York; Fred. H. Baldwin, Asst. Engineer Croton Aqueduct, Tarrytown, N.Y; W.J. Haskins, New York; P. A. Peterson, Superintendent Engineer Canadian Pacific Railway, Montreal; F. O. Norton, New York; Geo. S. Morison, New York; Thos. Egleston, Prof. Columbia College, New York; Bryant Godwin, Pres. Liberty Machine Works, New York; Walter Katté, Chief Eng., N. Y. W. S. & B. R. R.; O. H. P. Cornell, New York: H. W. B. Phinney, Pres. Eng., Harlem Riv. Bridge; Ellis B. Noyes, New York; F. W. Watkins, Div. Eng., Aqueduct, New York; Geo. H. Norman, Newport, R. I.; O. E. Michaelis, U. S. A. Philadelphia; John Houston, Jersey City; Horatio Allen, South Orange, N. J.; A. B. Hill, City Eng., New Haven; G. S. Greene, Jr., Dept. Docks New York; Chas. E. Emery, New York; Geo. H. Frost, Ed. ENGINEERING NEWS, New York; P. H. Dudley, New York; S. A. Harrison, Milwaukee, Wis.; Wm. E. Kelly, New Brunswick, N. J.; Albert Fink, New York; Julius W. Adams, Past. Prest. Am. Soc. C. E.; Alfred P. Boller, New York; Geo. C. McNulty, New York.

VISITORS.

S. Oshima, C. E., Japan; R. Du Puy; C. P. Bennett; C. M. Daniells, Buffalo, N. Y.; Capt. Carl Stuart, R. S. E., Stockholm; H. C. V. Moller, C. E., Copenhagen, Denmark; S. Huntingdon, Jr., American Exhibition, London, England; Senor Malo, City of Mexico; Prof. W. F. Wittemore; Myron Hume, Eng. Corps, Central Park; D. D. Negus, Supt. Utah & Wyoming R. R. Co.; A. S. Mills, Otis Elev. Co.; J. F. Lewis, Mining Eng., New York; Fred. E. Kelly, New York; Chas. Colne, Panama Canal Co.; Lewis Evans, Pottstown, Pa.; M. Isaaci, New York.

Panama Canal.

According to the *Bulletin du Canal Interoceanique* of Jan. 1, the following is the last report of work done:—Amount excavated in November 1884: 735,348 cubic yards.

Total work done to November 30th, 1884: 12,616,913 cubic yards.

The rains have been exceptionally heavy and frequent during November, only eleven days of effectual work being possible. The work at the Culebra had also been temporarily suspended during its transfer to the new contractors. M. Dingler announces that he has made a contract with Cutbill, De Lungo, Van Hattum & Co. for work on the Culebra, down to elevation 50m. above bed of canal. The minimum monthly output is to be 910,000 cubic yards —all work to be done at the end of October 1886, This is the Anglo-Holland contract spoken of in the press, and includes a total of about 24,000,000 cubic yards.

The London-American Exhibition of 1886.

AN Exhibition, purely American in all its parts and characteristics, but held in London, is the bold and novel programme outlined by its projectors, and now being vigorously pushed by trained and experienced men. This project, to be inaugurated in May, 1886, is to be devoted to properly placing before Europe, and the world of trade generally, the arts, inventions, manufactures and products of the United States. And instead of asking all interested nations to come across the Atlantic to inspect the possibilities of our land and the advance made since 1876, it is proposed to go to them, by locating the exhibit in the commercial metropolis of the world.

There is a peculiar fitness in the selection of London for this purpose. For we wish to teach, and nowhere else can we find so many apt pupils; it is to our interest to extend the market for our wares, and in no other one spot can we find so many prospective buyers. And beyond all mere selfish aims of personal profit, the end will be to still further strengthen the existing ties of friendship between ourselves and the country whence we derive our mother tongue and the sturdy Anglo-Saxon blood which makes our advance noteable in the world's history and our prosperity great beyond comparison.

As a measure of its probable success we have the statistics of the International Fisheries Exhibition of 1883, with an attendance of 2,703,051 persons; and the still more brilliant exhibit of the late International Health Exhibition, with 4,167,681 visitors. With the experience of these Exhibitions to guide them, united, as it in the case of General C. B. Norton, the Secretary, to all that gained in the great World's Fairs that have gone before, we see no reason why this American Exhibition should not at least equal these predecessors. We have much to show the world that is novel and valuable in our manufactures, peculiar in our social development, and great in our natural resources. But to make it worthy, both of the location and the importance of the interests involved, our American producers and inventors must take vigorous and timely action. If any incentive to make the most of such a display was ever wanting, it has been supplied by the experience of the past year. We now know that we make more than we can consume, and to extend the demand we must first show other nations what we can supply and what it is like.

It is expected that the U. S. Government will, at the present session of Congress, warmly second the efforts being made at home and abroad for insuring success to the Exhibition of 1886. The general public is not asked for financial aid, and the Government is only required to assume the expense connected with the transfer of its own exhibit, now in New Orleans, to London, at the close of the present Exhibition. The London managers are men of ripe experience in exhibition matters, and are building on a sound business basis, and we predict success and a most appreciative greeting by our cousins across the ocean.

THE government directors' report of the Union Pacific railroad shows, among other things, that the free passes issued by the company umounts to nearly $1,000,000 a year.

The Adirondack Water Supply for New York and the Hudson Valley Cities.

J. T. Fanning, C. E., has published Report No. 2, on the Water Supply for New York and other cities of the Hudson Valley. Mr. Fanning has made an elaborate study and exhibit of the probable future demand for water for the city or New York, and from the data thus collated shows that some other source than the Croton River must eventually be looked up to meet this increase.

The maximum Croton supply is put down at present as 250 millions of gallons daily. Mr. Fanning, judging from the recorded consumption for the years 1842 to 1875, figures out an estimate of the future consumption and reaches 290 millions daily in 1900, a period only 15 years distant. The mean rate of *annual* increase from 1860 to 1875 is about 4½ per cent., and the increase per *semi-decade* is about 24⅜ per cent. Assuming the last percentage as the basis of calculation, in 1930 the demand would exceed 1,100 millions of gallons daily.

In studying the increase in population, the author finds that from 1800 to 1880, the average increase has been 46.64 per cent. per decade, while the increase for the last four decades preceding the civil war exceeded 60 per cent. Assuming 50 per cent. increase per decade as a fair basis of computation for the next 50 years, the estimated population of New York in 1900 would be 2,714,800; in 1910, 4,072,197; in 1920, 6,108,295, and in 1930 it would reach 9,162,443. This would mean a population of nearly 10 millions and a water consumption of about 1200 millions of gallons in New York City within the next half century. In this computation the ratio of increase in consumption per capita is taken into account, due to the extension of commercial and manufacturing interests and for other legitimate purposes; this ratio is assumed as rising gradually from 95 gallons per head in 1875 to 140 gallons in 1930.

To meet this future and vast demand for water, Mr. Fanning looks to the Adirondack region, with its 3,000 square miles of available water-shed, as the only available and the best point of supply. The rain-fall records made it safe to assume a total of 40 inches per annum on this upper Hudson water-shed; this would give a flow in the stream of upwards of 5,000 millions of gallons daily. But allowing 20 inches for flood waste, evaporations and for the various processes of nature, and the reduction of this volume in seasons of drought, and an ample allowance for the manufacturers and canals, there would be left 9⅜ inches available for storage. With reservoirs properly located and constructed this would provide for an even flow in the aqueduct of 1,392 millions of gallons daily.

Maps accompanying the report show the various lakes of the water-shed which might be utilized.

The aqueduct would have to be substantially built, of sufficient area to provide for the ice on the surface in winter, and covered in the vicinity of all villages at once, and in its whole line as soon as found desirable. The aqueduct would start on the upper waters of the Hudson with an elevation of 350 feet above tide, at Troy it would be 286 feet; at Albany, 283 feet; at Poughkeepsie, 248 feet; Peekskill, 229 feet; at Yonkers, 213 feet; and at New York and Brooklyn, 200 feet. The entire Hudson Valley would have the benefit of the supply, and the census shows that one million people in 44,000 dwellings, live along the route outside of New York City. The head provided for New York, would meet all the requirements for higher pressures; and could the New Croton Aqueduct be made to carry the increased pressure, the problem would be somewhat easier for solution. The estimate of original cost is placed at $55,000,000 in round figures.

The scheme proposed by Mr. Fanning, is certainly of rather collossal proportions, but in this era of great undertakings it is not beyond the range of possibilities. If the time should come when the Croton water-shed would be found inadequate to meet the demand—and the folly of discounting the future has been too often proven to say it will not—the Adirondacks, with its abundant and pure water-shed, seems to be the only sufficient and lasting source available. In any event Mr. Fanning has gathered an interesting and valuable amount of data in presenting his projected plan for a future supply.

PERSONAL.

THE building commissioners of the new Georgia capitol have selected DAVID W. CHAMPAGNE, of Columbus, as superintendent of construction.

SAMUEL M. FELTON, JR., has been elected Vice-President of the Eire Railroad Co. MR. FELTON is only about thirty-one years old. He is the son of Samuel M. Felton, a prominent promoter of railroads, for years President and Manager of the Philadelphia, Wilmington and Baltimore R. R. Co., and now President of the Pennsylvania Steel Co., of Harrisburg, Pa. The son graduated in Civil and Mechanical Engineering at the Massachusetts Institute of Technology, and practised as a civil engineer, first on the Philadelphia & Reading R. R., then as General Superintendent of the Pan-Handle R. R.; next as General Manager of the New York & New England R. R. and last as Assistant to President and General Manager Jewett of the New York, Pennsylvania & L. Erie R. R. MR. FELTON has marvelous capacity for work, a strictly practical but analytical mind, and wide experience.

MR. JAMES TILLINGHAST, of the Wagner Company, began his career in 1850 as fireman of the Utica and Schenectedy Road, now a part of the New York Central. Within a year he was appointed Master Mechanic and Assistant Superintendent of the Rome, Watertown and Ogdensburg. From 1856 to 1864 he was Superintendent of the Motive Power and Assistant General Superintendent of the Toronto Northern Road. He was then appointed Master Mechanic of the Western division of the Michigan Southern, and then became Assistant General Superintendent of the Buffalo and Erie. He then became division Superintentendent of the New York Central, and afterward General Superintendent, succeeding to the Presidency of the Canada Southern, he became in 1881 Vice-President of the Wagner Company. Last April he was promoted to the Presidency of the Company, and also Assistant to the President of the New York Central Road.—*Exchange.*

Engineer's Club of Philadelphia.

RECORD OF SEVENTH ANNUAL MEETING, JANUARY 10, 1885.

President William Ludlow in the chair; 56 members and 4 visitors present.

The Secretary and Treasurer presented his Annual report. The expense for the year amounts to $3589.05; the receipts and other funds to $4413.81, leaving a balance of $824.76, or more than double the very satisfactory showing of last year. This is, of course, in addition to the value of the library and furniture.

The average attendance of members at meetings was over 54 per cent. greater than it was during the year 1883. The active membership of the club has increased, during the year, from 244 to 363, or nearly 49 per cent.; 45½ per cent. of the members now reside without the city, and 23 per cent without the State.

Club mail matter is now issued at the rate of about 15,000 letters and packages per annum.

President Ludlow delivered the Annual Address.

He drew a rapid picture of the universality of modern activity and means of communication, and briefly depicted the astonishment of an ancient philosepher, could he be recalled to participation in the life of to-day. The restless activity of mankind in every corner of the globe is directed by careful study and observance of natural laws. The specialization of knowledge naturally follows from its vast accumulations, but the Engineer should be careful to thoroughly ground himself in fundamental principles, and maintain his acquaintance with kindred lines of thought. The progress of civilization has been effected by the discovery and utilization of natural laws, by means of which man has emerged from a savage state and become a ruler of the earth, pressing into service all the powers of nature and using them to his advantage.

The engineering history of the past year was briefly gleaned over and the principal features mentioned, including the improvement of the Mississippi River and the construction of tidal harbors. The prospect of a revival of military engineering in America was touched upon, with the accompanying development of the metallurgical arts in the construction of guns and armor.

Under the general title of Sanitary Engineering in the broadest sense, are included nearly all those branches which affect the existence and prosperity of cities; water supply, sewerage, bridges, street cleaning and paving, etc.

Speaking of Philadelphia engineering, he said: "While serious attention has been drawn to the improvement of its water supply, the prospect of actually entering upon the construction of the necessary works is vague and distant. The streets are covered with a pavement which, in all well regulated cities, has long since been abandoned as costly to traffic, impossible to clean, permeable to street fluids, noisy and hopelessly disreputable. But one sound bridge across the Schuylkill exists. The Fire Department labors under the most serious disadvantages from lack of water. The city sewers are without means of flushing or cleansing, and many are so constructed as to waste their contents. In consequence the foul matters are either to a great extent stored up under the pavements to give out poisonous vapors, or saturate the soil in which the dwellings are constructed. * * * I look forward with the eye of hope to the future of the city; with smooth, noiseless, water-tight pavements; ample facilities for connecting the population of West Philadelphia with the old city; rapid transit of the population from point to point in decency and comfort; clean streets, healthful homes, pure air and pure water. I anticipate the reconstruction of the sewers upon a well considered and scientific system."

A project for the useful disposal of Philadelphia sewage upon the sandy and thirsty farms of New Jersey by means of intercepting sewers, a conduit beneath the Delaware, and a distributing aqueduct eastward, was briefly sketched. The several scientific assemblies in Philadelphia during 1884 are mentioned, and in conclusion the Club is congratulated upon its great prosperity during the year, and a continuance for the future anticipated.

The deaths of members Arthur Robert Faunt Le Roy and William Lorenz were announced.

The Tellers of Election, Messrs. J. E. Codman and T. M. Rogers, reported that the amendment to the Constitution creating the class of Associate Members had received 136 affirmative and 12 negative votes, and was, therefore, carried; and that 153 votes had been polled for Offices for 1885, with the following result:

President, J. J. de Kinder; Vice President, Joseph N. DuBarry; Secretary and Treasury, Howard Murphy; Directors, T. M. Cleemann, Frederic Graff, Rudolph Hering, William Ludlow and Henry G. Morris.

Mr. de Kinder assumed the chair with appropriate remarks. He specially urged increased social and professional activity in the Society, and the full contribution by each to the general store of information.

HOWARD MURPHY,
Secretary and Treasurer.

Nebraska Association of Engineers and Surveyors.

The Annual Meeting of the Nebraska Association of Engineers and Surveyors was held in Lincoln, January 13, and 14. 1885.

In adition to considerable routine business, papers were read as follows:

"The Sewerge System of Omaha," George W. Tillson.

"The Survey of a Section," G. A. Kilpatrick.

"The Survey of Town Lots" by E. C. Simmons.

"Street Improvements in the City of Omaha," A. J. Grover.

"The Well for the Water Supply of the City of Lincoln," J. P. Walton.

"What is a Surveyor and What Constitutes his Duties," C. H. Holmes.

"Riparian Rights," George Smith.

The following officers were elected for the year 1885;

President—J. P. Walton.

Vice President—G. A. Kilpatrick.

Secretary—Geo. W. Tillson.

Treasurer—A. B. Codding.

Executive Committee—W. T. Richardson, Geo. Smith, L. H. Spencer.

The Association adjourned to meet in Omaha in January, 1886.

CORRESPONDENCE.

Credit to Whom Credit is Due.

CHIEF ENGINEER'S OFFICE, S. P. R. R.
SAN FRANCISCO, Jan. 8, 1885.

EDITOR ENGINEERING NEWS:—I see in your paper of December 27, a notice of the death, at Omaha, of Mr. John Henry Hobart, C. E., and stating further that he built the celebrated Loop Curve on the line of the Southern Pacific Railroad in the Tehachapi Pass. As this statement is going the rounds of the engineering papers, I would like to place the credit of the Loop location and construction rightly before the public. The Loop was conceived by the Chief Engineer, Col. Geo. E Gray, and most ably laid out by his Chief Assistant, Mr. William Hood (now Chief Engineer of the Central Pacific Railroad). The construction was in charge of the writer, and Mr. Hobart was his assistant as transitman and leveler; in this way he had his share in the building of the celebrated Loop.

Yours very truly.
LOTT D. NORTON,
Asst. Eng. S. P. R. R.

Bridge Disasters.

GULF, COLORADO AND SANTA FE RAILWAY, ENGINEER DEPARTMENT.
GALVESTON, TEX., Jan. 11, 1885.

EDITOR ENGINEERING NEWS:—In your issue of January 3rd, you say "with more mathematics applied to their designing, the Ashtabula and Tay Bridges would have been constructed to safely bear the heaviest trains and greatest winds, and would still have been standing." In this connection will you please favor your readers with a brief review of the generally accepted causes which led to the deplorable accidents at the above mentioned bridges, and also at the St. Charles bridge, and oblige. Yours truly,

A READER.

[The Ashtabula bridge failed on account of the weakness of certain wrought-iron struts used for chords and braces. The bridge carried a double track, but at the time of the accident only one was loaded. Under this load a number of the struts had factors of safety less than 2.0, several being as low as 1.5 and 1.2. The investigating committee reported that these and other defects in the structure could have been discovered at any time by careful inspection and mathematical analysis. The Tay bridge failed on account of the weakness of cast-iron columns and wrought-iron braces composing the piers. The investigation showed that no computations had been made to provide against wind stresses, and that the columns and braces were too weak to resist the lateral pressure caused by the gale.—ED. ENGINEERING NEWS.]

Concrete.

PITTSBURGH, PA., Jan. 17. 1885

EDITOR ENGINEERING NEWS:—I would like to have the opinion of yourself and your readers on the following question:

The specifications of a certain contract for concrete specify that the concrete shall be composed of one part cement, two parts sand and five parts broken stone.

For the sake of convenience the contractor uses empty cement barrels, using one barrel of cement, two of sand and five of broken stone, and to which arrangement no objections are offered by the engineer.

Subsequently the contractor discovers that a cement barrel holds three bushels according to measurement. He then proceeds to measure the cement into a bushel measure, using three of these of cement to two barrels of sand and five of broken stone as before.

In doing this he finds that there is yet one bushel of cement remaining in the barrel, and which remaining bushel the engineer insists shall be used as before in one mixture but which the contractor refuses to do claiming that he has *literally* fulfilled his contract to the letter. Now who is right?

CONCRETE.

(The specifications call for a proportionate *volume* of cement, sand and broken stone: this is the proper meaning of the word "part." We can only explain the fact of the "one bushel of cement remaining in the barrel" by supposing that, in the measurement by the bushel the cement was not as solidly packed as it was in the barrel. Hence the volume in the three bushels was not equal to the volume in the one barrel, and the contract was not "literally" fulfilled. We should say the engineer was right, as we understand the proposition.—ED. ENGINEERING NEWS.

Who Invented the Steam Hammer?

TRANSLATED AND COMPILED FOR ENG. NEWS.

In the recently published *Autobiography of Jas. Nasmyth*, edited by Samuel Smiles, an account is given of the invention of the steam hammer, which has been the means of calling out an interesting paper by M. Boutmy, presenting the French view of the same subject. Nasmyth's account of the invention is briefly as follows: In 1838, the steamer Great Western (1,340 tons), comparatively large and powerful for those days was making its transatlantic trips, and was considered so successful that a much more powerful steamer, the Great Britain, was designed. That was before the screw-propeller had been successfully used, and the vessels were propelled by paddle wheels. In designing the intermediate paddle shaft of the engines for this vessel, it was found that it required to be so much larger than any forging that had previously been made, that no tools could be found with which to do the work. Nasmyth, who was connected with the company that proposed to build the steamer, was appealed to, to design suitable machinery with which to do the forging, and "immediately set himself a thinking." The problem was to design a hammer that would forge a shaft thirty inches in diameter. The forging hammers in use at that time were modifications of the smith's hand hammer, and when tilted by steam or water-power to its full height and allowed to fall by gravity, its range was so limited that when a large piece of work was placed upon the anvil, the hammer became "gagged," and the blow had little or no effect. Nasmyth sought to obtain an increased weight of the hammer, and a greater range in falling; and the result of his "thinking" was a plan in his "scheme-book," under date of November 24th, 1839, of a steam hammer essentially similar to those now in use.

But before he could put his plans into execution the immediate necessity for that particular steam hammer ceased to exist. In 1840, the first naval screw vessel, the Archimedes, was built for the British Navy, and it was so completely successful that comparatively few transatlantic steamers were afterwards built with paddle wheels. On the strength of its success, the design of the Great Britain was so modified as to change her from a side-wheeler to a screw-propellor; and as there was no heavy shaft to be forged, the steam hammer was not built.

Nasmyth then submitted his plans to the heads of several large iron works, who cordially approved his plans and highly commended the simplicity, unity and apparent power of his hammer; but the hard times, which set in about that time in the iron trade, and the consequent lack of orders for iron work, prevented any of them from taking up his designs and constructing the machine.

It was Nasmyth's custom, as a matter of policy, to exhibit freely to his foreign customers and visitors to his works at Patricroft, not only his tools and mechanical appliances, but also his scheme-book of designs. About the time of which we are writing his works were visited, during his temporary absence on the Continent, by M. Schneider, proprietor of the well-known iron works at Creusot, in France, and his mechanical engineer, M. Bourdon. Mr. Haskell, the partner of Mr. Nasmyth, showed them the scheme-book containing the plans for his steam hammer. Nasmyth says they were impressed with its simplicity and apparent practical utility, and that "M. Bourdon took careful notes and sketches of the constructive details of the hammer." Nasmyth returned and was told of the visit, but gave it very little additional thought. Nothing was done for several years towards putting his plans into practical execution.

In April, 1842, while visiting France, Nasmyth visited the works at Creusot. While there he was struck with the excellence of a large wrought-iron marine engine single crank, forged with a remarkable degree of exactness in its general form, and also with the smoothness and truth with which the eye had been punched and drifted.

He inquired of M. Bourdon "how that crank had been forged. His immediate reply was, "*It was forged by your steam hammer.*" M. Bourdon then took him to the forge department that he might, as he said, "*see his own child,*" and Mr. Nasmyth says, "there it was, in truth—a thumping child of my brain! Until then it had only existed in my scheme-book: and yet it has often and often been before my mind's eye in full action." Upon his inquiry how he became acquainted with the idea of his steam hammer, M. Bourdon narrated the circumstances of his visit to Patricroft, as given above, and stated that immediately on his return to Creusot, "he had set about the construction of a steam hammer, and that the results had in all respects realized the high expectations he had formed of it." After inspecting the steam hammer Nasmyth pointed out several important details that had been omitted, which had led to a few mishaps, for which M. Bourdon expressed his obligations in the warmest terms; and the alterations were shortly afterward made with very satisfactory results. Mr. Nasmyth returned to England and hastened to secure letters patent, which he had not done before because of the excessive cost. The patent was received in June, 1842. Its after success is well known.

In the story narrated in full in the autobiography, as in the resume given above, Nasmyth claims the entire and sole originality in the invention of the steam hammer, and charges, or at least allows the inference to be drawn, that M. Bourdon was entirely indebted to him, or to the plans which he had seen in his office, for the idea of his steam hammer.

It is to refute this view of the case, and to represent the claims of M. Bourdon to an *equal* share in the invention, and *priority* in the execution of the design of the steam hammer, that M. Boutmy has written his memoire "On the First Application of the Steam Hammer."*

M. Boutmy was a designer and draughtsman under M. Bourdon, in the establishment at Creusot, at the time when the latter was engaged in his preliminary studies and sketches for the steam hammer, and was familiarly acquainted with every step in the process of designing and constructing the first hammer under these plans. He therefore feels himself impelled by his friendship and love for his old master, to recite in detail the history of the latter's work in this matter, as derived from his own recollections and from documents and sketches to which he has had access. He first gives a brief resumé of the state of the iron industry at the time under consideration, the rapid increase in the size of the forgings called for, and the necessity that was felt, in England as well as in France, for more powerful hammers than were in vogue (about 1840); and he further states that in both countries several engineers were working on the problem of applying steam power in some direct way to the operation of the forging hammers, and that among these engineers were two of exceptional merit, Jas. Nasmyth, in England, and Francois Bourdon, in France, who were working on the same lines unknown to each other. Nasmyth made a simple sketch of his project incomplete in its details, and there let it rest. Bourdon made a complete design, in detail, of a steam hammer which he executed in 1840, and which was patented Sept. 30, 1841. Nasmyth did not know of this invention until 1842, and did not at that time make any claim: and it was not until 1844, at the time of the holding of the French Exposition—to which one of the Bourdon hammers had been sent as an exhibit—that he claimed the exclusive priority of the invention in the "*Moniteur Industriel.*" This gave rise to a discussion between the rival claimants, which was closed by a letter written by M. Bourdon, which will be referred to later on. The discussion has been reopened by the publication of the "Autobiography" which M. Boutmy says renews the old pretensions of Nasmyth, "entering into details which give the work of Bourdon a character of plagiarism and piracy." He therefore gives in detail the history of the invention of which the following is a brief resumé:

In 1839 M. Bourdon first had in definite form the idea of a direct acting steam hammer to which he gave in his conversations with the author, the name of "pilon," which it still preserves in France. He not only made a sketch, but detailed drawings, which were shown to all the engineers who visited Creusot. At this time the idea of this apparatus seemed so bold that the Messieurs Schneider hesitated for a long time in deciding upon the execution of the plans. Towards the middle of 1840, M. Eugene Schneider and M. Bourdon, went to England, and, as related by Mr. Nasmyth, visited the works at Patricroft, and were shown the plans of Mr. Nasmyth. They found these plans incomplete, "not responding to the ideas of Bourdon, who mentioned his objections, spoke of the project which he had designed in France, and made a pencil sketch of his design." M. Schneider was so impressed with the fact that two such eminent engineers were working on the same line that he immediately wrote to his brother at Creusot: "on our return we must put the steam hammer of M. Bourdo in execution." The steam hammer was then constructed after the designs of 1839.

*Memoires de la Société des Ingénieurs Civils, Aug. 1884.

It had been in successful operation fifteen months, when, in April, 1842, Nasmyth made the visit to Creusot, to which reference has already been made. M. Boutmy gives the following account of the interview that took place on this occasion between Nasmyth and Bourdon, at which he was present. Nasmyth showed them his album of designs, which led to a conversation on tools and appliances, in the course of which Bourdon asked him if he had followed up his design of a steam hammer. He replied evasively, "that it was still a design only, but that he expected soon to put it in execution." Bourdon than showed him his design for a steam hammer, and asked him what he thought of the arrangements. After a long examination Nasmyth made but one objection. This referred to the arrangement for taking up the shock of the blow, for which he suggested an improvement. Bourdon explained that in constructing the machine he had changed the plans so as to obviate this difficulty in a perfectly satisfactory way. He then took Nasmyth to see the machine in operation, who after viewing it a short time said to Bourdon, "I am enchanted to see with my eyes what I have so long had in my head."

M. Boutmy positively affirms that Bourdon's view of Nasmyth's sketches did not cause him to make any changes in the plans which he had designed before his visit to England. He does acknowledge, however, that this view did put a stop to the hesitancy of MM. Schneider, and hastened the execution of Bourdou's plans. This circumstance would give an appearance of justice to the criticism against MM. Schneider and Bourdon, if they, in their visit to the works of Nasmyth, had been satisfied to examine the sketches shown them without referring to their own designs; and Nasmyth even essayed to present this view of the matters, in his letters of 1844, in the discussion above referred to. But as has already been stated this was not the case. M. Schneider stated in one of his contributions to the discussion in the *Moniteur Industriel*, of 1844, that he not only had mentioned the fact of his having designs, but had also made a pencil sketch of them. According to M. Boutmy's showing, Mr. Nasmyth was treated in a perfectly fair and honorable manner by the MM. Schneider and Bourdon; and, the author says, as the Bourdon steam hammer preceded by two years the steam hammer of Mr. Nasmyth, to MM. Schneider belongs the honor, because of their great sagacity in having foreseen the future of this admirable machine, and in taking the lead of the English constructor.

As related above, Mr. Nasmyth lays stress on the facts that Bourdon had called the steam hammer "his (Nasmyth's) own child," on the occasion of his visit to Creusot, and considers it an acknowledgment by Bourdon of his (Nasmyth's) claim to the design. M. Boutmy refers this remark to the amiable character of Bourdon, "so benevolent and so modest that he attributes his own merits to others." In 1844, Nasmyth wrote a letter abjuring Bourdon to confess that the success of his steam hammer had been due to his having been shown the sketches at his office, and to the advice which he, Nasmyth, had given him at the time of his first view of the machine at Creusot. Bourdon replied by a letter dated June 2, 1844, to which reference has before been made, in which occur the following passages: "I know that they (Nasmyth and Gaskell) sought to realize the idea of a steam hammer, of which the details, still incomplete, differed essentially from the project which I have executed as it was conceived by me. . . . I presented this machine to him, not as his hammer, but as the realization of an idea which he had had with me."

M. Boutmy, in summing up, closes as follows: "For my part I leave to Nasmyth the entire merit of his machine, and I do not doubt that he would have made it succeed in England, even if he had not first seen it in operation in Creusot. We would respect, in France the glory of Nasmyth, as we would have respected in England the glory of Bourdon, our respected compatriot."

With these two accounts of the invention of the steam hammer to choose from, it is difficult, if not impossible, to decide on the merits of the case. To accept Mr. Nasmyth's view is to judge M. Bourdon guilty of dishonorably appropriating Nasmyth's designs. To accept M. Boutmy's view is to accord equal honor to both inventors without detracting from the honesty of either. In England the sole honor will doubtless be accorded to Nasmyth; but as Americans, without national prejudice to warp our judgement, and with the evidence at hand so evenly balanced, we will probable be more inclined to accept M. Boutmy's view, and divide the honors evenly.

TRACK.*

BY W. B. PARSONS, JR., C. E.
ROADMASTER SUSQUEHANNA DIVISION ERIE R. R.

(*Continued from page 45.*)

Furthermore as the bottom of the angle is turned over the base of the rail it gives an increased bearing on the ties, and what is a still greater advantage, permits the plates to be spiked independently of the rail. In both the chair and fish-plate joints the rails are held from creeping by spikes driven in slots in the rails themselves, which is a great mistake. When the rail has expanded or contracted until it is fast against the spike any further movement must be obtained by crowding the spikes.

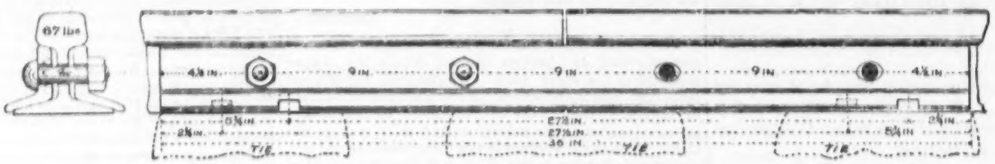

FIG. 42. STANDARD RAIL JOINT, N. Y. W. S. & B. R. R.

If a rail is to be spiked in a slot it should be at the center. All this is obviated in the angle plate, the slot being cut in the flange of the angle. Now, while each rail is free to contract and expand to the limit, the string of rails as a whole is firmly held against creeping or running. These spikes moreover hold the plates in place even after the bolts loosen. Hence we can sum up its advantages:—First; increased vertical and lateral strength with elasticity retained. Second; suspended joint. Third; track is held from creeping although each individual rail is allowed to expand freely.

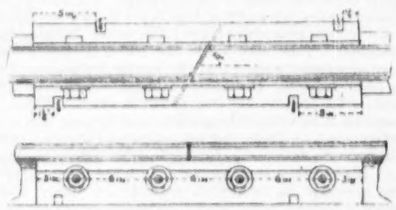

FIG. 43.—THE SAYRE JOINT.

The sizes of the plates should be so proportioned as to afford as closely as possible the same strength as the body of the rail (many of the present angle plate joints give but about 60% of this) and yet retain the same elasticity so as to transmit unbroken the wave of depression. A sort of combined supported and suspended joint is that shown in Fig. 42, the standard of the N. Y. West Shore and Buffalo R. R.

Its adherents claim that the arguments against a supported joint are not applicable to this, for although there is a tie under the joint, it is merely an aid to the weak joint and not the main support, which is given by the long plates resting on the two adjoining ties. There is thus obtained the advantage of the support of the one, and elasticity of the other form of joint and a bearing on three ties. The adverse criticisms are, as in a bridge, that it is impossible for two separate systems to work together; in the end one of them will do all the work. So here, even if the three ties could be so tamped as each to carry its due share, it is not possible for them to remain so, either the centre tie will be packed too hard, making a weak and cumbersome supported joint or else this centre tie will be slack, and the joint be a long and very weak and suspended one.

More probably, however, the third tie (calling third in direction of traffic) and which has to resist the "drop," will be the one to loosen, leaving the other two firm; then the plates will break at the joint. Another objection is the necessarily small space between the joint ties, which is but 6 in.; if they are all 8 in. face there is not room enough to tamp. If experience proves such a combination of supported and suspended joints a success, it would seem better to increase the length of the plate to 39 in. and use six instead of four bolts.

As was previously remarked, one of the great causes of weakness in the joints is the, at present, apparently necessary expansion space between the rail ends. Every wheel that strikes it is made to jump and "drop" on the rail head at about 3 in. from the joint, and it is here that rails first begin to give out. Many attempts have been made to remedy this drop. Some years ago the N. Y. Central tried a rail in three sections split longitudinally and laid so as to break joints, but it failed. Several kinds of joint fastenings have been devised to carry the wheel tread over the gap, but they wear unevenly and soon fail. In 1867, Chief Engineer Robert H. Sayre, of the Lehigh Valley R. R., began experiments with a skew joint shown in Fig. 43, (Sayre Joint) at which time he laid twenty iron rails cut at an angle of 60°. They wore out without the joints showing any defect. About a year since the Philadelphia and Reading and the Lehigh Valley each laid a string of skew cut joints, some cut at an angle of 60° and some at 45°, all of which are doing well. These experiments thus far conducted seem to show that the skew adds materially to the strength of the joint, and certainly to the easiness of the riding of the track.

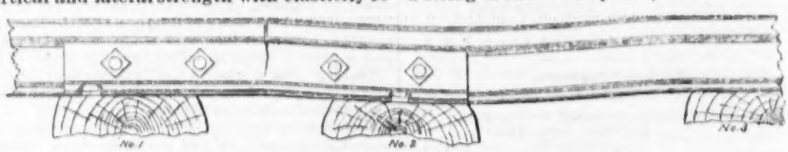

FIG. 44.—BROKEN ANGLE-PLATE.

Mr. Sayre made some comparative tests of the square and skew joints and found the latter "much the stronger vertically."

The inconvenience of patching a break with such a joint can be overcome by having on each section a half rail with one end cut skew and the other square.

The continual hammering caused by the "drop" either breaks the angle plates or gives them a permanent sag. To correct this, (and it should be done,) some roads change all their plates periodically every two or three years. The life of the plates, however, and with them that of the joint can be materially lengthened by keeping the joint ties always sound and well tamped. The ties on the "drop" side of the joint receive the force of the blow, and are always the first to loosen, therefore they should especially engage the trackmen's attention. The failure to keep them firm is the general cause of broken angle plates.

So when the angle plates break, do not attribute it entirely to their weakness unless they

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give by sagging in the centre, but rather look to the track and see if the prime cause is not there, with a condition of affairs of which an exaggerated view is shown in Fig. 44. You will find that the tie just past the joint is either rotten or loose, so that when the weight is on the rail, the latter deflects and bends down the plate, bringing a strain of tension at the top. If this strain exceeds the strength of the plate the latter will break in the centre. A splice bar is intended to act as a girder, and the strain in the bottom of a girder supported at both ends is tension; therefore when the plates tear apart at the top it shows that the strains have been reversed, and Fig. 44, explains this occurrence. It is a sure sign of defect in the track, and it will pay to watch it closely.

When angle plates are found broken they should be at once replaced, and the breaking cause, if in the track, should be remedied.

(TO BE CONTINUED.)

The Science and Practice of Engineering.

Really we ought, with the amount of literature and teaching at our elbows nowadays, to be unable to go far wrong; but it is a fact that hardly any work of magnitude is undertaken without loud expressions of dissent from those who have lost the work. Professor Kennedy, a short time since, when opening the session of the Crewe Scientific Society, dealt trenchantly with the diverse yet cognate subjects of science and practice. Referring more directly to the engineer, how far and how often, he asked, could an engineer arrive at definitely valuable results by calculation?

"To what extent could calculated results be taken to represent actual facts, and trusted in design and construction? These questions concerned all of them in different degrees, and on their answer to them depended to a great extent their method of work. It happened to be his good fortune to be at the head of a laboratory where they had special facilities for making inquiries into this very matter, directly and indirectly. He was therefore all the more ready to take that opportunity to speak about it.

In the first place, he said that an engineer could never expect to arrive at valuable or trustworthy results by means of calculations taken from books, calculations which he did not understand, 'rules,' so called, from pocket-books, etc. Pocket-books, etc., were all very well to remind them of formal facts which they forgot or did not carry in mind, and to give by tables the results of long arithmetical calculations. This was their legitimate and very important function. But directly it came to taking up a formula which one did not understand, *a's* and *b's* and *c's*, putting in values and calculating results merely by rule of thumb—as far as oneself is concerned, the result was worth absolutely nothing, and few, if any, sensible men would trust such a result. In his mind, that definitely put an end to the idea of certain mechanical engineers about universal engineering dimensions all ready calculated.

There was plenty of engineering work to be done without actual formulæ—the object of so much dread and scorn—done well, and done scientifically. It was a great advantage to a man if he could follow the reasoning physical or mathematical, on which other parts of engineering work, and especially design, depended. Fortunately for some of them, there was for the most part no necessity that a man should be a great mathematician in order to be a fairly competent engineer.

Professor Kennedy had, or had had, the pleasure of knowing personally some of the greatest mathematicians of our time. With one exception, not one of them would make his mark as an engineer, even if he confined himself to the scientific side of his work. He had also the pleasure of knowing some of our greatest, some of our most original, and long-headed engineers, and, as far as his knowledge went, hardly one of them had such aptitude for mathematics as would place him in even the second or third rank of mathematicians, if he devoted himself to that most fascinating subject. But all the same there were engineers in plenty—not certainly as many as could be wished—who had succeeded in grasping thoroughly the science, mathematical and physical, of their profession without having lost the peculiar bent of mind which specially adapted them to be engineers. And into this class they doubtless wish to enter, so far as circumstances allowed.

The late Professor Rankine long ago pointed out that the so-called discrepancies between "theory" and "practice"—between results theoretically best and those practically best—did not exist, could not exist, if only the theory were right. He feared they got into rather a slovenly way of talking on this subject sometimes. They said that a certain system of levers should theoretically enable them to lift 1,000lb. with 10lb. pressure, but that practically it only enabled them to lift 500lb. This simply meant that the theory was wrong, or at least incomplete.

A complete theory would take into account all the friction at all the joints, giving to each its proper coefficient; all the variations from accuracy in the length of the levers, and so on. But if one chose to take the theory on an ideal combination of frictional ones, of course the results would show a discrepancy. This reason was not to be sought in any fault in the theory, but in themselves, for expecting it to apply to a set of conditions for which it was by no means adapted."

Thus we see that the Professor agreed that theory was frequently imperfect or wrong, and even when correct required for right use the aid of experience. It is experience, and experience alone, which counteracts the evils of mere scholasticism, and prefers to have a larger margin of safety than pure theory supports. We have always advocated a deference to the opinions of experienced men, and have frequently shown the bad results which often follow the neglect of their suggestions.—*London Contractor.*

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E. : M. INST. C. E.

Continued from page 45.

DCCX. ELKHART, IND.

Elkhart, Elkhart County, Indiana, in lat. 41° 40′ N. long. 85° 50′ W., is in level country on the St. Joseph River, into which at this point the Elkhart River and Christiana Creek flow, each of the two latter streams furnishing good water power, which is extensively used for manufacturing purposes.

Water-works were built by a private company, in 1884, after plans and under the direction of M. M. Moore, C. E., the supply being taken from ground water. On an iron shoe 30 ft. in diameter, a well curb of brick laid in Portland cement 16 in. in thickness, was built 24 ft. high, and then sunk in a bed of gravel 32 ft. deep on the bank of Christiana Creek, by excavating the gravel to a point 25 ft. below the surface. The yield of the well was then tested by pumping at the rate of 600,000 gallons per day, the result being that after three hours pumping, the water was lowered 6.4 ft., at which point it remained during the remainder of the test. From the well the water is pumped by two compound duplex pumps of 20 and 14 in. steam and 11 in. water cylinders, and 15 in. stroke, made by Fairbanks, Morse & Co., lifting 90 ft. to a wooden tank 30 ft. in diameter and 20 ft. high, set on a timber trestle 70 ft. in height. A fire pressure of 80 to 140 lbs. is attained by pumping directly into the mains. Distribution is by 7.5 miles of cast-iron pipe of 12 to 6 in. diameter, with 84 fire hydrants, 33 gates and 57 taps. There are no meters used. Services are of lead and iron. The city pays yearly $75.00 each for the use of hydrants.

The population in 1880, was 6,953, and is now said to be 10,000. The capital stock of the company is $100,000, which is the amount of the bonded debt at 6 per cent. The works have cost $90,000.

C. H. Morse is President, M. M. Moore, Chief Engineer and C. H. Watson, Superintendent.

DCCXI. EPHRATA, PA.

Ephrata, Lancaster County, Pennsylvania, in lat. 40° 10′ N., long. 76° 20′ W. on Cocalico Creek, was settled early in the 18th century by the religious sect termed Dunkers.

It possesses mineral springs of some repute. It has never been incorporated. Water-works were built in 1879 by a private company, taking the supply from springs, from which it is conveyed to the village by gravity and distributed by one mile of cast-iron pipe of 6 to 4 in. diameter with 6 fire hydrants. The daily consumption is 1,000 gallons.

The works have cost $5,000. There is no bonded debt. The yearly expenses of maintenance amount to $50 and the receipts $300. The population in 1880 was 392. Wm. Z. Sener is President, and D. J. McCan, Secretary. No further information can be obtained.

DCCXII. FAIRFIELD, IA.

Fairfield, Iowa in lat. 40° 55′ N., long. 91° 50′ W., the County seat of Jefferson County, is on Big Cedar River, on a prairie.

Water-works were built for the city by Geo. B. Inman, in 1884, after plans of Chester B. Davis, C. E., the supply being taken from surface water.

A dam of earthwork and masonry about 500 ft. long and 35 ft. high, forms an impounding reservoir, from which the water is pumped by a Blake duplex steam pump of 1,000,000 gallons daily capacity, to a stand-pipe.

Distribution is by 45 miles of cast-iron pipe, with 32 fire hydrants, for each of which the city pays $50 annually. No service pipe have as yet been put in. The works have cost $53,000 and have not as yet been turned over by the contractor to the city. The bonded debt is $25,000 at 5 per cent.

The population in 1880 was 3.086.

Charles D. Leggett is Chairman of the Water-works Committee.

WATER.

BELLE VERNON, Pa., contemplates water-works.

BLACKMER & POST are now filling a large order for sewer pipe to the city of Oswego, N. Y.

CHATHAM, Ont., is agitating the subject of a water supply.

BORING for natural gas has commenced at Morgantown, W. Va.

PINE Bluff, Ark., is discussing electric lights and water works.

NATURAL gas companies have recently been formed at Wooster, Toledo, Painesville, and Ashtabula.

THE city authorities of Valparaiso, Ind., have contracted for water-works to cost $80,000.

FORT Shaw, Mont., is to be provided with water works to cost $10,000. Water will be pumped from Sun River into a tank sixty feet above the water's surface.

MONTGOMERY, ALA., has asked of the State Legislature privilege of issuing $100,000 of bonds to provide a system of water-works, which has been granted.

J. W. SLOSS, Jos. F. Johnson and others of Birmingham, Ala., have organized a company to build water-works at that city. It is thought the water will be brought about 12 miles.

THE Water Trustees of Youngstown, O., awarded, on Jan. 13th, the contract for 190 tons of 20 inch pipe to the Lake Shore Foundry Co. of Cleveland. Price not stated.

REVERE, MASS. WATER-WORKS.—The Revere and Winthrop Water-works have just been completed. Tests made last week were entirely satisfactory, and the works have been accepted by the towns.

THE Toronto, Canada, water works have now 138.75 miles of mains, with 19,750 consumers. The revenue has increased in two years $58,337, and the net profit for 1884 was $25,000. There are now 107 miles of sewers in the city.

THE greatest amount of wrought iron pipe ever run through a single furnace in a single turn of nine hours was run on January 1 at the Conshohocken Tube Works. Six hundred and ten lengths of 2 inch pipe, weighing about 18 tons, was the yield. This, it is said, has never been equaled by any tube works in the country.

FISHER'S Pipe Foundry, at Allentown, which suspended operations two months ago on account of lack of orders, throwing about 80 men out of employment, resumed operations on December 29 with a full set of hands. Orders have accumulated lately which, it is believed, will keep the works going the remainder of the winter.

BIDS were opened on the 14th, in the Department of Public Works Chicago, for water pipes of from six to twenty-four inches in diameter. The whole quantity the city will use is estimated at 3,000 tons. The lowest bid was made by the Lake Shore Foundry Company of Cleveland, O., which will be awarded the contract at prices ranging from $24.50 to 25.80 per ton. The pipe has to be delivered at the yard of the West Side Pumping Works.

THE Contract for building the Manheim, Pa. Waterworks was awarded, on Jan. 14th, to Harvey Tyson, of Reading, Pa., for the sum of $24,350. It is to be finished in August, 1885.

WATERTOWN, MASS. WATER-WORKS.—After fifteen years hard fighting, the above town has secured a public water supply. As soon as the two Deane pumping engines are ready to work, water will be turned on, which is expected to be Feb. 1st, next.

THOMPSONVILLE, CONN., WATER WORKS. To be built this coming season. 6000 inhabitants. Goodhue and Birnie, Springfield, Mass., Contractors. *Steel pipe* to be used exclusively. Pipe to be made of rolled steel plate, riveted, and cement lined, inside and out. We believe this is the first use of steel in the construction of water pipe.

THE water supply of Paterson, N. J., was cut off this week by an accumulation of anchor ice in the large reservoir. It was drawn against the filter and there froze.

THE Council Bluffs water works, completed January 10, 1883, have now 23 miles of mains of 30 to 4 inches, and 202 fire hydrants. The combined reservoir capacity is 16,500,000 gallons. The works have given complete satisfaction in the first year.

THE Winchester Arms Company of New Haven, Conn., has finally abandoned work on the artesian well which it began sinking two and one-half years ago, with the idea of obtaining an inexhaustible water supply. After the bore had been extended 2400 feet, some one dropped pieces of iron into the hole, and they wedged in about 50 feet of steel-boring tube. This was several months ago, and all efforts to clear out the hole have proved ineffectual. The only bore in the world deeper than the Winchester is a Pennsylvania oil well. It has cost the company over $25,000.

SUPERINTENDENT STETSER, of the Camden Water Department, has completed his report of the operations of the department during the past year, and it will be submitted to the City Councils at the next meeting. The report states that there are 7963 dwellings connected with the water mains. About 1,212,167,697 gallons of water were used during the year, the greatest number consumed in one day being 6377 gallons. These figures represent an increase of 14 per cent over the consumption during the year 1883. The department yielded a profit to the city of $45,000. The Superintendent recommends the adoption of meters and the taxation of consumers according to the amount of water consumed. He also advises the construction of a new reservoir.

THE ELKHART WATER-WORKS.

PITTSBURGH, PA., Jan. 19, 1885.

EDITOR ENGINEERING NEWS.—In your article on Elkhart Ind., Water-works, in NEWS of January 17, 1885, in seventh line from the end you use the expression, "with the *exception* of etc." If you had omitted the word "exception," I should have made no exception to the article. With this word in, this Company did very little.

In point of fact this Company had the contract for the *work complete*, and SUBLET the several parts of the work as you have given it.

Yours respectfully,
JAS. H. HARLOW, Pres
Water and Gas Works Con. Co.

SANITARY WORKS AT WOLVERTON, ENG.—The new sewage works at Wolverton have just been opened. They were constructed under the supervision of Mr. James Lomax, C. E., of Bolton, and the principle of the operation is known as Lomax's quiescent precipitation system. The sewage from the town is received in 12-inch pipes, which form a syphon, and convey the sewage into a water-wheel of 11 feet diameter and 3 feet wide, which provides power for the mixing apparatus, being worked by a shaft from the wheel. When the sewage has passed on to the wheel it proceeds forward to the mixer, which agitates and moves the precipitant in the sewage; it then goes along, through iron troughs 2 feet wide, to the sludge-tank, into which it is conveyed over the side of the trough in a thin film, by which the sewage is acted upon by the atmosphere. The size of the sludge-tanks is 80 feet by 25 feet, and they are capable of holding 31,000 gallons of sewage. They are two in number, and they work alternately, so as to enable the attendant to remove the sludge deposited therein without stopping the operation of the work. From the sludge-tank the sewage, after a considerable amount of precipitating, is again conveyed by iron troughs to the precipitating tanks, three in number, which also work alternately. After the first tank is full, it remains quiescent till the second is full, and while this is proceeding the first is being let off into the filter bed. The size of the precipitating tanks is 80 feet by 30 feet, and they are capable of each holding 60,000 gallons. From the precipitating tanks the sewage passes into the filter-beds, two in number, which work alternately. These filter-beds are 30 feet by 30 feet, and are composed of good well-washed sand and gravel. The condition of the sewage before it passed over the wheel was exceedingly dirty, offensive and nauseous, but upon entering the sludge-tank it had been entirely freed from smell, though retaining its dirty appearance, having been acted upon by the precipitant. After the operation, there was not the slightest indication of smell arising from the works. Upon a careful examination of the effluent water as it passed into the Ouse two years after the works were opened, it was perceived to be nearly clear and pure; in fact, so much so, that a bystander drank a glassful as a test. The works were commenced on April 23 in the present year. Their estimated cost was 4,467*l.*, but the engineer is confident they will be completed under that estimate.

NEWS OF THE WEEK.

Contracting.

Toronto, Canada, has 164 miles of street pavement, 35¾ miles being block pavement.

Collecting Sewer Grease.—Covington, Ky., offers for sale, to the highest bidder, the right to collect grease from several of the city sewers.

Union Depot at Nashville.—The burning of the Louisville and Nashville depot at Nashville, Tenn.—it is hoped will result in the building of a Union depot at that point. The encouragement is slight however.

The Sny Levee.—The government engineers are examining the Sny Levee, preparatory to making a report concerning the claims of the Levee Commissioners for a $50,000 appropriation to strengthen it.

Miss. Levees.—The Commissioners of the Fourth Levee district will ask the government for aid in perfecting levees from Red River to the Gulf. The danger from overflow is immenent, and they are pecuniarily unable to provide against it.

Water Gas.—Des Moines has rejected the proposition of a water gas company to build works and furnish gas at $1.25 per 1000 feet, and has contracted with the old gas company for 10 years at $2.50 per 1000 feet.

Wilmington, Del. Drainage.—Geo. E. Waring, Jr., has submitted to the Board of Trade of Wilmington, Del., the outline of a system of drainage to cost $200,000. It is expected that a sewer construction company will be shortly organized.

A Pittsburg Hotel.—A hotel is to be built in Pittsburg seven stories high, with the kitchen on the top floor and an electric fire-escape in every room. The escape is to be operated from the office. By touching a button there the guests are simultaneously aroused, every window thrown open and a flexible ladder loosened that reaches to the ground.

Charges of Fraud.—The Commissioners of Huntingdon Co. Penna., are charged with having a received a consideration for a Rochester, N. Y. iron firm for awarding the contract for the iron in the cornice, roof, tower, etc., of the new County Court House. The Commissioners deny the charges.

Louisville Items.—Louisville, Ky., reccommends the expenditure of $60,000 on street improvement in 1885. There is no appropriation for sewers. A bridge, 125 feet span, was finished over Beargrass Creek, on Jan. 14; cost $25,000. The Dry Run Sewer has been completed at a cost of $110,000.

Fourteen-foot Bank Lighthouse.—The Lighthouse Board in Washington, on Jan. 15, opened bids for the construction of the foundation for the lighthouse on fourteen-foot Bank Shoals, in Delaware Bay. The bidders were Wm. Sooy Smith & Son, Chicago, $42,891; W. E. Chapman and Morris D. Flynn, New York, $51,990; John F. Anderson and C. C. Barr, Philadelphia, $38,000; J. E. Robinson, Baltimore, $42,000. The *Press*, of Philadelphia, states that the contract has been awarded to the firm of Anderson & Barr.

Toronto Harbor.—The contractors for the Toronto Harbor improvements expect to finish their work this year. About 10,000 cubic yds. of dredging have been done at 15½ cts. per yard. Messrs. Hunter and Murray have contracted to continue the dredging at the same price. Mr. Kivas Tully, engineer of the Board again calls attention to the necessity for the construction of a trunk sewer along Front St., and also the diversion of the River Don into Ashbridge's bay by crib-work and stop logs. Much annual dredging would thus be saved.

The St. Louis Board of Public Improvements received proposals on Jan. 16, for street paving. The following bids were received.

Almond street, from Fourth to Broadway, John S. Wright, $3,485; Wm. Skrainka, $3,863; Allen & Vieths, $3,929, and Gottlieb Eyerman, $3,658.

Fourth street, from Elm to Market street, John S. Wright the lowest bidder, at $12,331 35.

St. Charles street, from Third to Fourth street, John S. Wright the lowest bidder, at $8,772 90.

St. Charles street, from Fourth to Fifth street, Wright the lowest bidder, at $1,800.

Seventh street, from Washington avenue to Franklin avenue, Wright the lowest bidder, at $15,257 65.

Market street, from Ninth to Twelfth street, Wright the lowest bidder, at $18,326 25.

Locust street, from Fourth to Sixth street, G. Eyrmann the lowest bidder, at $8,204.

Mr. Wright was also the lowest bidder for the reconstruction of Chestnut street, from Fourth to Sixth street, at $11,449 25, and Pine street, from Fourth to Sixth street, at $8,459.

Bridge Letting.—Grafton Co., N. H., is about to let the contract for a new wrought-iron bridge.

Philadelphia Street Maintenance.—Bids were opened on Jan. 19, for the maintenance of unpaved public highways, macadamized streets, and small bridges in Philadelphia. They were divided into ten districts, with the highest and lowest bidders as follows: First Ward—D. & P. McNichol, $2,500; Alexander Patton, $600. Twenty-sixth Ward: D. McNichol, $3,000; Alexander Patton, $800. From the Second to the Twentieth Wards, inclusive, the Twenty-eighth, Twenty-ninth, Thirtieth and Thirty-first Wards: W. B. M. Conklin, $4,800; D. McMahon, $2,500. Twenty-first Ward: P. Schwars, $2,985; D. McMahon, $2,240. Twenty-second Ward, North: D. McNichol, $3,500; D. McMahon, $975. Twenty-second Ward, South: D. McNichol, $4,000; Benjamin McCarthy, $1,950. Twenty-third Ward, North: James Brown, $5,700; D. McMahon, $2,899. Twenty-third Ward, South: W. B. M. Conklin, $4,353; D. McMahon, $1,790. Twenty-fifth Ward: W. B. M. Conklin, $3,800; D. McMahon, $1,660. Twenty-fourth Ward: T. P. Smart, $3,800; D. McMahon, $1,840, and Twenty-seventh Ward: D. McNichol, $2,500; H. Muherrin, $1,150.

Miscellaneous.

St. Louis Cable Road.—Col. M. A. Downing has let the contract for 30 cars, including 15 grip-cars, and 24 coaches. The contract for the conduit has been let; it includes 1,900 tons of metal.

Indianapolis Items.—The city engineer is ordered to advertise for bids to widen the State ditch as soon as plans are completed; also to construct a 3 ft. sewer on Coburn St. The street department expended, in 1884, $42,985.54.

A Mississippi Bridge to be Built.—An exchange says that an iron bridge, one mile long, is likely to be built soon over the Mississippi River, between McGregor, Ia., and Prairie du Chien. It will be part of the Chicago, Milwaukee & St. Paul system.

Osage Dam and Lock Scheme.—Maj. Ernst, U. S Engineers, reports against the scheme to improve the Osage River, in Missouri by dams and locks. He says the attempt would be useless, and that the interests represented by commerce on this stream would not warrant so great an expenditure, if it were possible.

The Public Buildings.—WASHINGTON, Jan. 19.—The House Committee on Public Buildings to-day decided to report Representative Stockslager's bill providing for the establishment of a Board, consisting of the Secretary of the Treasury, Postmaster-General, Attorney-General, Supervising Architect, and an architect appointed by the President, who shall select sites, and superintend the erection, of public buildings.

Revision of the Philadelphia Warden's Line.—Maj. H. H. Heuer, U. S. Engineers, has presented to the Philadelphia Board of Port Wardens, plans for a revised Warden's line in which a maximum depth of 28 feet from the city to the sea is suggested. The proposition was favorably received, and Councils are urged to give it their early consideration.

Sioux City Bridge Scheme.—A party of Boston capitalists propose building a bridge across the Missouri River at Sioux City, Iowa, if a survey should indicate that a bridge can be built for $1,200,000. To determine this a survey of seven miles of the river—four above the city and three below it—is wanted. Also soundings of the river at various points, and borings to ascertain the depth to bed rock. City Engineer, L. F. Wakefield, has been instructed by the City Council to proceed with the survey.

East River Bridge Travel.—Mr. C. C. Martin, Chief Engineer and Superintendent, has examined, and declared against, a proposed method of increasing the car accommodation, by a different plan of handling and switching. He says the only feasible method, and one by which the capacity can be doubled, is by increasing the bridge trains to four cars each. This is only possible when more switching room is obtained at the New York terminus. The rolling stock now on hand is ample for this increased service. One and a half minutes is as close as safety will permit trains to be run, as it requires one minute to unload the cars.

Rivers and Harbors.—WASHINGTON, Jan. 18.—The House Committee on Rivers and Harbors to-day decided to recommend the appropriation of $15,000 for the New Orleans harbor, on the ground that it was a harbor of refuge and that the city was a great seaport. An appropriation is recommended of $350,000 for the Big Muscel Shoal, and $5,000 for the Tennessee River above Chattanooga.

The committee decided to recommend the appointment of a Commission of seven members to examine the work in progress on the various rivers and harbors, and report to Congress, the Commission to be in existence one year. At the adjournment of the Committee late this afternoon the advisability of recommending an appropriation for the improvement of the Galveston harbor was under consideration. It was determined to invite General Newton, Chief of Army Engineers, to give his views on the project to the Committee to-morrow. The proposed amendment will necessitate an aggregate

appropriation of $7,750,000. The contractor will be required to make a channel thirty feet deep.

Council Bluffs, Ia.—During 1884 the city of Council Bluffs, Iowa, expended for public improvements as follows:

Sidewalks, curbs and gutters	$ 35,000
Sewerage	75,000
Paving	235,000
Grading	415,000
Bridges	28,000
Street railway	20,000
Water works	32,000
Total	$940,000

The Nitro-glycerine Powder Works of Beach & Wolf, situated on the line of the South Pa. R. R., built and operated to supply Thos. Collins and other contractors near Somerset, Pa., exploded about 1 P.M. the 13th inst. only one of the employes escaping uninjured. Two were so badly burned that they died during the evening. The others were not considered dangerously injured. One of the dead men admitted before death that he had caused the explosion with sparks from a heated iron he was using to burn a hole through the packing house door. There was probably 400 lbs. of nitro-glycerine and about 1,000 lbs. of mixed powder in the packing house. Other property was destroyed, but the total loss will not exceed $1,000. As soon as new stock arrives they can resume manufacturing.

New County Prison for Phila.—The Prison Committee of the Philadelphia Councils had a meeting on Jan. 19. Dr. Gaspar Wistar, President of the Board of Inspectors of the County Prison, stated to the gentlemen of the committee that his board had purchased twenty-seven and one-half acres adjoining the House of Correction grounds on the west. The price given was $500 per acre, the various figures asked for other less eligible sites running from $2,500 per acre down to $500. The inmates of the House of Correction will dig the necessary foundation trenches, and quarry the stone for the inside walls. The total cost of the buildings and walls is expected to be about a million dollars. The walls will be thirty feet in height, and enclose an area of from twelve to fifteen acres. The prison proper will be but one story in height, and without a cellar. It is intended to hold between 900 to 1,000 prisoners.

Railroads, Bridges and Canals.

The Wilmington, Onslow & East Carolina R. R projected, as is also a road from Wilmington to Fayetteville.

The Manchester Ship Canal.—The promoters of the Manchester ship canal scheme have made a deposit of £279,000 in accordance with the terms of the bill.

The Pine Bluff, Monroe & New Orleans R. R. has been corporated with office at Pine Bluff, by C. M. Neal, C. M. Neal, Jr., M. L. Bell and others. Capital stock $1,000,000.

The Hancock & Calumet, Mich. Railroad Company filed articles of association, Saturday 17th, capital stock $300,000. The road will be narrow gauge, 18 miles in length, running from Portage Bridge, via the village of Lake Linden, to the village of Red Jacket.

A Florida R. R.—Report has it that a scheme is afloat to build a new railroad from St. Anthony's Bay, Fla., to the interior of Alabama. D. C. Aldrich, Esq., of Chicago, is said to have secured a grant of 257,000 acres of pine land on the route. The company capital is $1,000,000 with Judge Aldrich as President.

Central Mass. R. R.—It is reported that an offer has been made by substantial parties to complete the Central Massachusetts Railroad to Northampton by next November, provided the stockholders will subscribe to $750,000 of the bonds. An effort to secure these subscriptions is now in progress.

The Montreal and Sorel Railway, forty miles long, on the south side of the St. Lawrence, was built five or six years ago by a speculator, who sold the bonds abroad, using the name of Lord Lorne as a bait, claiming him as an investor. There was no business for the road, except a very little obtained in competition with the Southeastern. It is a total failure.

The Meiggs Railway.—Jos. Meiggs has got a charter for an experimental road of his single rail type, from Boston to Cambridge, Mass. It will be an elevated structure on pillars. One mile of track will be built over the freight track of the Boston & Lowell R. R. crossing the Charles River at Cragil's Bridge.

Erie Retrenchment.—The Erie R. R. is said to be tiring of its Narrow Guage System the Bradford, Bordell & Kinzua, the Bradford, Bordell & Southport, Kendall & Eldred, Rew City and Tonawanda Valley. The Erie has made no direct effort to cancel the contracts, but tells the holders of bonds that it can not pay the coupons now and don't know when it can.

$1.00 from New York to Chicago.—The Pennsylvania R. R. has cut rates with a vengeance by fixing the immigrant rate at $1.00 from New York and Philadelphia to Chicago and other Western points. This action was taken on account of other parties in the pool agreeing to make the rate as low as to Chicago.

Laredo, Tex. Bridge.—A $300,000 bridge will probably be built across the Rio Grande at Laredo.

Texas Improvements.—FORT WORTH, TEX., January 14.—The Fort Worth and Denver is making preparations to put a corps of engineers on the road from Wichita Falls to Vernon in Wilbarger County, and to-day asked the County Commissioners for right of way through the county school lands in Wichita County. So the early extension of this road is looked on as an assured fact.

The Keystone Bridge Co.—Mr. A. Gottleib, the president of the Keystone Bridge Co., and Mr. John Strobel, secretary and treasurer, have resigned their positions. Mr. A. R. Griffin, who represented the Edgar Thomson Steel Works in Chicago, has been chosen to succeed Mr. Gottleib as president and Mr. J. H. Springer, Sr., who had been superintendent of the shops, has been chosen general superintendent of the works.

N. Y. & Boston Inland R. R.—A large number of men and teams were put at work grading for the New York and Boston Inland Railroad at East Medway and Sherborn. The sum of $50,000 must be spent in actual construction by day in order to save the charter. Probably this object will be accomplished if the accounts are not too carefully audited, and probably the work will then cease until the company gets more completely ready to resume it.

The Chesapeake & Nashville R. R., is located to Scottsville Ky., and estimates made thereon. Preliminary survey commenced on the 13th through Edmonton, Ky. to Columbia, Adair Co.; thence to Liberty Casey, Co., thence to some point as yet undetermined—connection with the Kentucky Central. Danville and Stanford are the most eligible points. Most of the right of way in Sumner Co. has been obtained, and it is expected that work will begin inside of sixty days.

Smoke Combustion.—Chief Engineer Tureff, of the Bee Line, has had engine No. 392, engaged in passenger switching, fitted up with a smoke consumer. It works on the principle of introducing a jet of steam over the fire. The smoke-stack is a straight, cast-iron affair, somewhat smaller than the old fashioned chimney and much more durable. The Chief Engineer declares that it is a consumer that consumes. It costs about $35.00 per engine.

New Albany Bridge.—Mr. John McLeod, Chief Engineer of the Kentucky & Indiana Bridge Co., reports as follows on the progress of the New Albany, Ind., bridge:—The stone work will be completed by March 15. The Delaware Bridge Co., the contractors for the superstructure, have contracted with the Cambria Co., for the steel. The bridge has cost so far nearly $400,000, and it is expected that it will be opened to traffic by June 1, 1885.

A New Missouri Road.—Chief Engineer McCabe, of the La Crosse, Iowa and Southwestern Railway, has completed his estimates for the work on a line running from St. Joseph through Andrew, Gentry, and Worth Counties to the south line of Hamilton County, Ia., a distance of over 227 miles. The aggregate cost will be $2,864,855.63 or an average cost of $12,664.37 per mile. It is said work will be commenced in the early spring.

Texas & Pacific R. R.—DALLAS, TEX., January 14.—It is stated to-day that as soon as the Texas and Pacific Railway has succeeded in disposing of the $6,000,000 terminal bonds recently issued, its track will be extended at once from Blanco Junction to El Paso, a distance of eighty miles, over the road-bed ready to receive the rail, which is to be steel. The eighty miles from Blanco to El Paso, now traversed by the trains of the Texas and Pacific, is a part of the Southern Pacific, and the extension of its own tract is made necessary by the strong competition at El Paso between that road and the Atchison, Topeka and Santa Fe for eastbound freight.

A Railroad Crank.—John W. E. Brown of Rumney, N. H., proposes to build a parallel road to the Boston & Lowell, from Concord to Woodville, in revenge for putting him off the trains. His capital stock is principally made up of the following draft which he exhibits:

PLYMOUTH, N. H., November 25, 1884.

The Pemigewasset National Bank:

Pay to the order of John W. E. Brown Five Billion Dollars.

THE RACE OF HUMANITY.

No good.

Mississippi River R. R.—Incorporated at Springfield, Ills. Jan. 15th to build a road from Jonesboro, Ill., southwesterly to a point on the Mississippi River at or near Thebes in Alexander County, there to connect upon a bridge over the Mississippi River with the track of a company of the same name organized under the laws of Missouri. The capital stock is fixed at $3,000,000. The principal business offices are to be at Mattoon, Ill. The incorporators are John Lee, of Crawfordsville, Ind.; Edgar P. Buell, of New York City; Robert Connelly, of Paris, Ill.; John C. New, of Indianpolis, Ind.; Duncan C. McIntyre, of Mattoon, Ill.; John W. Kitchell and Henry H. Deming, of Pana, Ill. The first board of Directors are John C. New, Edgar P. Buell, Robert Connelly and Henry H. Deming.

Lake Erie and Western, R. R.—J. H. Cheney, Vice-President of the Lake Erie and Western Railroad, has just returned from New York, whither he has been to raise money with which to build this road on to Peoria. J. P. Cummings, President of that road, left lately for New York for the purpose of completing negotiations. The officials are confident the road will be built into Peoria next summer.

Burnt Clay Ballast.—The Meadville (Mo.) *Messenger* says that the Hannibal and St. Joseph Railroad managers are preparing to ballast the track of the road with burnt clay, and have let a contract for eighty miles of the work. The ballast contractors will begin work immediately. The scheme contemplates digging the clay and burning it, and using the material in place of stone and gravel.

The B. & O. Bridge, Havre de Grace.—Col H. T. Douglas, the Chief Engineer says that the masonry of the B. & O. bridge over the Susquehanna, will be finished by April 1, next. The iron superstructure will at once be erected from "false-works erected on scows and towed into positions." There will be 2,000 linear feet of iron bridge on the Delaware Division of this road. There will be 20 overhead bridges in Delaware and Maryland. Of the eleven in Delaware four are yet to be built.

Railways of India.—The total railway mileage of India, as appears from the latest report, is 11,025¾ miles. Since March 31, 1883½ miles have been opened for traffic and are included in the aggregate given above. Lines amounting to 14,450 miles in addition have been sanctioned. India contains about 1,000,000 square miles, with only about 11,000 miles of railway, while the United Kingdom has a railway mileage of about 18,500 with 121,305 square miles of territory.

New York Lines.—The annual report of the Board of Railroad Commissioners of New York shows that the total number of tons of freight carried one mile by the railroads in that State during 1884, was 9,322,518,571, an increase over 1883 of 36,301,943 tons. The total number of passengers carried one mile, exclusive of the elevated railroads, was 1,729,653,620, against 1,720,377,410. The total earnings were $126,304,164 against $133,980,625. Amount of dividends paid $17,893,315; against $18,271,124. The total amount of stock and debt September 30, 1884, was $1,268,220,758, and the total miles of road in the State 7,298. Discussing the demoralization and losses incident to rate wars between parallel roads, the report says: "It is urged that one lesson to be drawn is the lack of wisdom on the part of the State in permitting any thirteen men who can secure subscriptions of $10,300 per mile, with 10 per cent. thereof paid in, to build a railroad anywhere they see fit, without an expression from the State of the public exigency for the same."

Massachusetts Railroads.—From the sixteenth annual report of the Massachusetts Railroad Commissioners—now Messrs. Thomas Russell, Edward W. Kinsley and Everett A. Stevens it appears 21.69 miles of railroad were constructed during the last year. The total length of railroads belonging to the sixty-three corporations making returns was 2851.743 miles of main line and branches, of which 941.627 were provided with double track. Last year the total length was 2782.903 miles, with 825.597 miles of double track; showing an increase of 68.840 of total length, and 116.000 miles of double track. The total length of sidings was 1165.207 miles, as against 1109.129; showing an increase of 56.078 miles. The total length of track, considering double track and sidings as so much additional single track, is 4958.577 miles, as against 4717.569 of last year; the increase being 241.008 miles. Of the whole amount there are in this State, of main line, 1973.708 miles; of double track, 667.889; and of sidings, 833.393 miles, being a total of 3473.990, as against 3339.803 miles of last year; showing an increase of track in this State of 134.187 miles. The aggregate capital stock was $127,668,390.27, an increase of $5,300,818. The net debt of the companies is $74,439,473.75, an increase of $1,506,182.82. The gross income was $43,119,302.70 a decrease of $261,084.93; the total expenses were $32,070,644.51, a decrease of $402,233.20; net income, 11,048,618.19, an increase of $148,138.27. The total amount of dividends paid was $6,535,054.92, an increase of $155,333.82; the amount of interest paid was $1,729,328.56. The number of passengers carried was 66,517,265—more than ever before—and the average distance travelled by each was 15.29 miles. The freight carried was 20,273,020 tons, an average distance of 60.64 miles. Passenger trains ran 15,157,425, and freight trains 11,282,238 miles. The average fare on all roads per mile was 1.92 cents. the Fitchburg rate, 1.65 cents, being the lowest, and the Connecticut river, 2.37 cents, the highest. During the year, 347,289 miles of steel rail were laid, as against 308,223 laid last year, making the whole amount now laid 3121.720 miles; being nearly 82 per cent. of the total of main line, including double track. The average number of persons employed was 30,590, being 746 more than in the year before. The whole number employed was 34,486. The report further says that there are 2,128 grade crossings in the State, 677 of which are protected by flagmen or gates. It is stated that to abolish all the grade crossings asked for by the Mass. Legislature would cost, at least, $100,000,000, the expense to be borne by the general public.

Recent Government Work.

GEDNEY'S CHANNEL.—Major G. L. Gillespie, of the Corps of Engineers, has submitted to General Newton, Chief of Engineers, a report relative to the deepening of Gedney's Channel through Sandy Hook Bar, New York. He estimates the cost of improving Gedney's Channel at $350,000, and of the main channel, $620,000. The Board of Engineers recommends several improvements for deepening the harbor so as to give 30 feet of water from New York to the ocean, the cost of which is estimated at from $5,000,000 to $6,000,000.

DURING the last year, work has been in progress on forty-two new buildings, under the direction of the supervising architect, of which number sixteen have been begun, five completed, and two others practically completed. The expenditures, during the year, on all new buildings, including sites, have amounted to $2,772,413.58; for repairs and preservation of public buildings, $164,102.32; for heating, hoisting and ventilating apparatus, and repairs to same, $135,000; for vaults, safes and locks, $80,332; and for storage of silver dollars, $85,402.32. The supervising architect, in his annual report, refers to three conditions which, under provisions of existing law, operate to the disadvantage of the Government, viz.: 1. The limit of cost of public buildings appears in many cases to have been fixed without sufficient regard to the needs of the public service in cities where the buildings are to constructed. 2. The appropriations, made from time to time within the limits of cost, are often inadequate for the proper prosecution of the work after its beginning. 3. Under existing law, no contract can be made binding the Government to an expenditure in excess of an existing appropriation. The remedies suggested by the supervising architect commend themselves to my judgment.—*Annual Report of the Secretary of the Treasury.*

THE Secretary of the Treasury has forwarded to Congress the additional estimates made by the Secretary of War. The estimates are as follows; Erection of a gun factory, $1,000,000; improving Missouri River, $1,160,000; Missouri River Commission, $150,000; Frankford Arsenal, Philadelphia, Pa., $7,000.

A BILL has been introduced appropriating $20,000 for the improvement of Big Black River in the State of Mississippi.

A PETITION asking for an appropriation for the improvement of the Red River of the North has been presented in the House.

THE Chamber of Commerce of Pittsburg, Pa., has petitioned Congress for the improvement of navigation and the removal of toll burdens on the Monongahela River.

THE Light-house Board has forwarded to Congress, through the Secretary of War, an estimate for an appropriation of $18,000 for completing the light-house and fog signal at the mouth of Detroit River, Mich. The board also asks for an appropriation of $200 for the establishment of a small-range light at Northwest Passage, Key West, Fla.

THE Chamber of Commerce of Eureka, Humboldt County, Cal., have petitioned Congress to appropriate $80,493.99 for the improvement of the harbor of Humboldt Bay, California, as recommended in the report of Lieutenant Colonel G. A. Mendell, Corps of Engineers.

THE Attorney General has transmitted to Congress a copy of a letter from Mr. Robert Furman, of Schenectady, N. Y., suggesting that, if the recommendation of the Attorney General that a United States penitentiary be erected is adopted, it be located at that place.

THE Supervising Architect has submitted to Congress an estimate for an appropriation of $30,000 for the completion of the post office at Poughkeepsie, N. Y.

HARBOR OF REFUGE AT LUDINGTON, MICH.—The Board of Engineers have made a preliminary survey for a harbor of refuge at Ludington, Mich., and its report giving details thereof has been transmitted to Congress.

THE detailed estimate of cost of widening the present entrance to Pere Marquette Lake, as recommended by the Board, is as follows:

800 feet pile revetment, with sheet piling at $27.54	$ 22,032 00
South pier, 1,050 feet piercing, 18 feet water, 6 feet superstructure, at $110	115,500 00
650 feet piercing, 20 feet water, 6 feet superstructure, at $1.50	97,500 00
North pier, 550 feet piering, 18 feet water, 6 feet superstructure, at $1.10	60,500 00
Removing old pier	25,000 00
	320,532 00
10 per cent. contingencies	32,053 20
	352,585 00
Dredging 222,000 cubic yards, at 30 cents	66,600 00
Total	419,185 20

The cost of removing the old pier cannot be estimated with any great degree of accuracy, still the figures given above ($25,000) are deemed large enough to cover any contingencies. There are, it is estimated, about 3,500 cords of stone in the old pier, most of which can be dredged up and saved.

BUCKHANNON RIVER, W. VA.—Captain James C. Post Corps of Engineers, in his report upon the work done on Buckhannon River, W. Va., transmitted to Congress, by the Secretary of War, estimates that it will require the breaking up of 78,850 cubic yards of rock and bowlders to open a channel 30 feet in width from the Three Forks to Buckhannon, and he places the cost of this work at 30 cents per cubic yard, because of the difficulties that will be experienced in transporting the materials required to the upper portion of the river. His entire estimate for clearing the islands, cutting the log-jams and breaking the rock is $23,955.

OSWEGO HARBOR BREAKWATER.—Lieutenant Colonel H. M. Robert, Corps of Engineers, in his report to the Secretary of War upon the Oswego Harbor breakwater, New York, makes the following statement of the extent of the damage done by the recent gale there, and the amount necessary for its reparation:

"(1.) The damage to the Oswego breakwater by the recent gale extends to about 150 linear feet of the west breakwater. The break occurred at a point from 500 to 600 feet of the angle where it has been breached some three or four times previously. The deepest part of the break extends to a depth of 12 feet below mean water level. Near by, at a point previously breached, there are signs that the work is impaired, the timbers being slightly separated.

"(2.) The cost of reparation I should estimate at $150 per linear foot for 300 linear feet of the breakwater, or $45,000 in all. The extension of the breakwater was in 1880 estimated to cost $130 a foot, based on the cost of the west breakwater, just then completed.

"For about 300 feet the old breakwater has been so often damaged that it should be torn down to the bottom and rebuilt more strongly than originally. Any repairs made as heretofore, superficially, will be useless. This tearing down and rebuilding on a stronger plan cannot safely be estimated at less than $150 per foot, as above."

ENLARGEMENT OF THE BASIN AT BLOCK ISLAND.—The Secretary of War, in response to a Senate resolution calling upon him to communicate whether there exists a public necessity for the enlargement of the basin or harbor inside the breakwater at Block Island, R. I., has transmitted a copy of the report of Lieutenant Colonel George H. Elliot, Corps of Engineers, in charge of the improvement of that harbor, containing the information desired. Lieutenant Colonel Elliot gives, in his report, after stating the necessity for the proposed work, the following estimate of its cost:

21,120 tons of riprap granite at $1.65 per ton	$34,848
Removing 4,000 tons of stones from the cribs which form the sides of the present inner harbor to the proposed inner breakwater, at 50 cents per ton	2,000
Breaking up and removing the old cribs	299
Building new crib-work above the low-water line at the inner end of the western part of the proposed inner breakwater	520
334 cubic yards of dry stone masonry in pier-heads at entrance to the new harbor, at $11 per cubic yard	2,674
Fenders and dolphins at entrance	748
	41,990
Add 10 per cent. for contingencies	4,199
Total estimated cost	46,189

Market Report of Engineering Materials.

New York, January 21, 1885.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer, and both the range of material and the market location will be extended as rapidly as possible. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.		
Angles	2.3c. @	2.6c.
Bridge plate		
Tee	2.8c. @	3c.
Beams and channels	3.5c.	
Tank	2.2c. @	2.3c.
Shell	2¾c.	
Steel plates, Tank	3c. @	3¼c.
WROUGHT-IRON PIPE, PITTSBURGH.		
Butt welded, black, Discount	45 @	45 & 5%
" " galvanized "	35	
Lap welded black "	65 @	65
" Galvanized "	45 @	45 & 5%
Boiler tubes "		
RAILS.		
Steel (large lots at mill)	$28 @	30
Old rails	16.50 @	17 50
Old steel rails	16 @	17
R. R. spikes		2c.
R. R. splice-plates	1.65c. @	1.75c.
R. R. Track Bolts	2¾c @	2¾c.
Barb-wire fencing, galvanized		5c.
" painted		4c.
Corrugated iron		
Nails.		
Iron	2.10, 2¾, 60d.	
Steel		

BRICK.

(Cargoes afloat)		
Haverstraw 1st, per M.	$6.00 @	6.12½
" 2nd "	5.50 @	5.75
Fishkill	4.75 @	5.50
Up-River	5.00 @	5.50
Jerseys	4.50 @	5.50
Long Island	5.50 @	5.75
" pale	3.00 @	3.25
FRONTS.		
Croton red	14.00 @	15.00
" dark	14.00 @	15.00
" brown	13.00 @	14.00
Philadelphia pressed	22.50 @	23.00
Trenton "	22.00 @	23.00
Baltimore "	37.00 @	41.00
Buff "	33.00 @	35.00
Enameled English	85.00 @	130.00
" American	85.00 @	120.00
Fire brick	25.00 @	35.00

CEMENT.

PORTLAND.		
Robins & Co., Extra English 425 lbs	2.75 @	2.90
K. B. & S. English 400 lbs	2.65 @	2.80
Burham " "	2.50 @	2.60
Rochester Castle " "	2.50 @	2.60
J. B. White & Bro. " "	2.50 @	2.60
Other brands, " "	2.40 @	2.50
Keene's fine " "	9.50 @	9.75
" course " "	5.25 @	5.50
Roman	2.75 @	3.50
Dyckerhoff, German 400 lbs	2.60 @	2.65
Star, " "	2.60 @	2.65
Alsen, " "	2.55 @	2.60
Hanover " "	2.40 @	2.50
Other brands, " "	2.35 @	2.40
Saylor's American	2.15 @	2.50

LIME.

Rosendale cements	0.90 @	1.00
Rockland common per bbl	1.00	
" finishing	1.20	
Glensfalls, common	.85	
" pointing	1.05 @	1.10
Kingston, ground	0.95	

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.90 @	1.00
" " No. 2 "	0.75 @	0.80
" " light drab "	0.80 @	0.95
Berlin " in rough "	0.75 @	1.00
Berea " " "	0.75 @	1.00
Brownstone, Portland, Ct. "	1 00	
" Belleville, N. J. "	0.75 @	1.25
Granite, rough	0.60 @	1.25
Common building stone per load	2.00 @	3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40 @	3.00

SLATE.

Purple roofing per square.	6.00 @	7.00
Green "	6.00 @	7.00
Red "	15.00	
Black Penna. (at New York) "	4.50 @	5.00

LUMBER.

PINE, Common box per M.	18.00 @	20.00
Good	55.00 @	60.00
Tally plank, 1¼ in each.	.44 @	.50
Tally boards, dressed "	.28 @	.30
SPRUCE, Boards dressed "	.25 @	.28
Plank, 1¼ in "	.28 @	.30
" 2 in. "	.38 @	.40
" 2 in. dressed "	.43 @	.45
Timber per M.	20.00 @	22.00
HEMLOCK, Boards each.	.18 @	.20
Joist, 2¼ × 4 to 4 × 6 in	.17 @	.44
OAK per M.	55.00 @	65.00
CYPRESS 1, 1¼, 2 and 2½ in "	35.00 @	40.00
YELLOW PINE, Girders "	26.00 @	35.00
Dressed flooring "	30.00 @	40.00
SHINGLES, Extra shaved pine, 18in. "		
" sawed " 18 in. "	4.50 @	5.00
LATH, Cargo rate "	2.50 @	2.60

PAINT.

Lead, white, American dry per lb.	.04¾ @	.05
" " " in oil pure "	.05½ @	.05¾
English, B. B. in oil "	.08½ @	.08¾
Red, American "	.05¾ @	.05½
Litharge "	.05 @	.05¼
Venetian red, American "	.01 @	.01¼
Indian red "	.05 @	.10
Vermillion, American lead "	.11 @	.11½
Paris green "	.15 @	.19
Umber, Amer. raw and powdered per lb.	.01¼ @	.01½
Drop black, Amer.	.08 @	.12
" "	.09 @	.11½
Chrome green	.05 @	.15
Oxide zinc, American	.03¼ @	.04
" " French	.06¼ @	.06¾

METALS.

COPPER.		
Lake Superior	11¾ @	.12
Other Brands	10¾	
LEAD.		
Com. Domestic	3.60 @	3.65
Lead Pipe	.06¾	
Tin-Lined Lead Pipe	.15	
Sheet Lead	.06¾	
ZINC.		
Sheet	.05 @	05¼

Bids Opened Jan. 21, 1885, N. Y. Dock Dept.

Repairing the crib bulkhead and its appurtenances, on Rivington St., E. R.:

J. D. Leary, $4390; Flaherty & O'Connell, $3398; Jos. Walsh, $3300; John Kelly, $2475; P. S. Ross, $3450; John Kelly receives the contract.

Repairing and extending Homeopathic Hospital Pier at Ward's Island, East River:

Walls & Van Riper, $7361; Flaherty & O'Connell, $7534; Jos. Walsh, $7140; John Kelly, $6650; P. S. Ross, $7350; John Kelly will be awarded the contract.

Repairing Pier 61, E. R: J. D. Leary, $4040; Flaherty & O'Connell, $4345; Jos. Walsh, $4290; John Kelly, $4400; P. S. Ross, $4750; Jos. Walsh receives the contract.

R. W. CLAPP, and John Mulford, of New York, and others, who are organizing the company to build a railroad from Weldon to Raleigh, report that surveys will be made at once.